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SERIE: PLANKTON · BIND I

Nr. 1. Ove Paulsen: PLANKTON-INVESTIGATIONS IN THE WATERS ROUND ICELAND IN 1903. (WITH 2 MAPS)

Nr. 2. C. H. Ostenfeld: ON TWO NEW MARINE SPECIES OF HELIOZOA OCCURRING IN THE PLANKTON OF THE NORTH SEA AND THE SKAGER RAK

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI
1904

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KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: PLANKTON

BIND I

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August 1904

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PLANKTON-INVESTIGATIONS

IN THE WATERS ROUND ICELAND IN 1903

BY

OVE PAULSEN

(WITH 2 MAPS)

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I. Introduction.

The material of the present report is taken partly from the collections of the "Hólar" during its regular summer-cruises between Reykjavik and Öfjord round the south of Iceland, partly from my own collections on board the "Thor", the marine investigation-steamer of the Danish Government, which spent the summer around Iceland.

The material from these two sources is not homogeneous. The collections of the "Hólar" were undertaken at previously determined places, which were the same on each voyage, viz: Vestmannaeyjar (only two samples), Hrolaugseyjar, Papey, Digranes, Langanes, Rödehuk (Rauðanúpur) and Gjögurtá. They are marked on map I.

My own samples, on the contrary, were collected at many different places and without regularity. The voyage of the "Thor" round Iceland was undertaken for fishing purposes, so its route was not arranged with a view to plankton researches. I gathered plankton everywhere on the voyage, and among the samples collected I have chosen seventy-two and grouped them into tables. These 72 samples will present a sufficient and, collectively, a convenient survey of the plankton-associations.

It will be seen that whereas the samples from the "Hólar" present a general view of the changes of the plankton-associations in the same localities at different periods, those gathered by the "Thor" enable us to study the changes of the plankton-associations in different localities often at nearly coinciding periods.

Therefore in the tables, the samples of the "Hólar" are grouped according to the places of collection. To each sample is added the date when it was taken, as well as the temperature and the salinity of the surface-water of the place in question.

In order to facilitate a general view, I have grouped the samples of the "Thor" in seven divisions each representing a certain area at a given period. The boundaries between them are often somewhat arbitrary, but I have attempted to make each of them embrace one or several tolerably well-defined and well-characterized plankton-associations.

These divisions are:

I. East Iceland, May.
II. South Iceland, June.
III. West Iceland, June.
IV. North Iceland, June-July.
V. West Iceland, July.
VI. East Iceland, July-August.

They follow in the same order in which the "Thor" traversed the waters in question. The terms: east, west etc. here are only meant to indicate the localities of the places of collecting in relation to Iceland. Where the same term recurs, it does not necessarily refer to exactly the same tract. For instance, the division headed West Iceland, June, consists for the most part of samples collected far out in Denmark Straits, whereas those of West Iceland, July, were taken closer to Iceland.

As we cannot provide hydrographic information about all the samples, none is given in the tables, but where it is possible we shall give it in our text.

The method of collecting used by the "Hólar" consisted in pumping up water which was subsequently filtered through a plankton-net; the pumping-tube opened about 3—4 metres below the surface of the water. The greater part of the samples of the "Thor" were gathered with a small horizontal net trailing behind the steamer at slow speed. Of the many vertical hauls that were taken I have only mentioned a few; they were all made with NANSEN's closing-net. Measures of volume have not been taken.

The determination of the material is defective in so far that only a small part of the zooplankton has been determined; the information we are able to give about that will be found in the tables as well as in the supplementary list.

II. Summary of the Hydrography.

Before speaking of the Plankton it will be to the purpose to give a general outline of the hydrography of the Icelandic waters. As the author of the present report does not profess to be a hydrographer the following summary could only be derived from second-hand knowledge. It will limit itself to giving a general sketch and refrain from entering upon details.

The waters of the sea round Iceland come partly from the north: Arctic water, partly from the south: Atlantic water, and partly form a mixture of these two kinds of water.

The Atlantic water is warm and of high salinity (over 35 ‰). According to all reports it seems to come from the south-west towards the south-coast of Iceland. The Arctic water, on the contrary, is cold and contains less salt (under 35 ‰); it flows from the north or north-west towards the northern Icelandic coast (forming part of the East-Icelandic polar current); the East-Greenlandic current comes less into consideration, as it does not immediately touch the Icelandic coast.

The Atlantic Water. According to KNUDSEN (Ingolf, p. 107), the ridge which from Reykjanes runs in a south-westerly direction, forms the boundary between Denmark Straits and the Atlantic Ocean. The current runs along this ridge, and at the south-west coast of Iceland it is supposed to divide itself into two branches, one that flows eastward, and one that flows northward, forming the Irminger-current.

Now, to begin with the easterly current, it must, at any rate in part of its course, follow the south coast of Iceland in an eastward direction. RYDER (1902), on the contrary, assumes that the warm current off the south-eastern coast of Iceland on meeting the East-Icelandic polar current is turned off and directed westward along the south-east coast of Iceland. Whichever may be the case, I cannot tell; from the side of the plankton the question is difficult to solve, for if the waters along the southern and western coasts of Iceland contain the same plankton — which may be the case at any rate — either of the two theories may account for the fact.

According to KNUDSEN, the sea south of Iceland presents very uniform hydrographic conditions. We find here a vast homogeneous area of warm and salt water covering a layer of colder and less salt water. — The surface-temperature is always positive; rising in spring and early summer, it generally reaches its maximum — as a rule between 11° and 12° — in the latter half of July. It is of high salinity, always exceeding 35 ‰, mostly about 35,25 ‰. Exceptions from this rule are rare (July 1899, KNUDSEN: Iagttagelser etc.). Close to the coast the salinity is less, see e. g. the observations of the "Hólar" from Hrolaugseyjar.

The above-mentioned Irminger-current flows northward along the west coast of Iceland, at the northern corner of which it divides into two branches, one of them running westward, the other eastward. The former is gradually forced southward by the East-Greenlandic polar current proceeding from the north; it pursues its course together with the polar current as its undercurrent and along its eastern side. As a part of the East-Greenlandic polar current is forced from south to north by the Irminger-current, we meet here in Denmark Straits with a rotation of "basin-water".

The eastern branch of the Irminger-current takes its course round Cape Nord and runs along the north coast of Iceland. According to KNUDSEN it passes Cape Nord mostly in the depths, not as a surface-current. At the north coast it is cooled by and mixed with polar water from the north. As far as Langanes KNUDSEN thought he could perceive the warmer water of the Irminger-current.

Therefore the waters on the west coast of Iceland are characterized by being warm and salt, in summer generally containing not less than 35,25 ‰ salt, and possessing the same surface-temperature as the water south of Iceland. In winter, on the contrary, the surface-temperature as a rule is lower than it is to the south of Iceland. The western side of the Irminger-current carries cold and fresh water, which, as shown above, it receives from the East-Greenlandic polar current. In the northern part of Denmark Straits, where the warm and the cold waters mix, we meet with irregular conditions, as for instance where HELLAND-HANSEN ($^{8}/_{8}$ "Michael Sars") in one place found a surface-temperature of 4° and a salinity of 32,78, a distance of a few cables' length showed 9° and 35,00 ‰ salt.

North of Iceland, on the contrary, the sea is comparatively fresh, and the surface-temperature — at all events in spring and early summer — lower than the west of Iceland. Later in the summer the difference in temperature gradually diminishes, but at that season the East-Icelandic polar current also possesses a warm surface-temperature. This proves, at any rate with regard to the polar current, that it is only the temperature of the surface-water which has been heightened by the effect of the sun. The 35 ‰ isohaline from the west never seems to come round Cape Nord. The salinities, as a rule, may be supposed to lie between 34 ‰ — 35 ‰, but where there is or may have been ice, even close to the coast, they frequently measure 33 ‰ or less, see e. g. the samples of the "Hólar" from Rödehuk and Gjögurtá.

The Polar Water. The East-Icelandic polar current proceeds from the north-west, passes Langanes and follows the east coast of Iceland. The polar water to the west of its northern part, according to KNUDSEN, flows southward, and it is this water which gradually mixes with the water of the eastern branch of the Irminger-current. This mixed water, together with all the fresh water from rivers and ice on the north coast of Iceland, especially at its eastern part, is carried away by the East-Icelandic polar current round Langanes, and pursues its course with the current on its western side, closest to the coast. Consequently the water is fresher here than further out in the sea. The water of the East-Icelandic polar current is cold and its salinity is small; the 35 ‰ isohaline passes from the south-east coast of Iceland round Vestrahorn south-eastward down towards the Færoes, or in summer it turns northward. In spring the 5° isotherme takes nearly the same direction, and so does in autumn perhaps the isotherme of 7° or 8°.

Then it is in passing Vestrahorn that the polar water meets the warm and salt Atlantic water, and in sailing round the south-eastern corner of Iceland we always notice a fairly sudden rise in temperature and an increase of salinity, so that towards the south the former amounts to a couple of degrees or more, and the latter changes from less than 35 ‰ to more. Of course we do not mean to say that these sudden changes always occur at the same points; we are only making general statements.

We can now resume our observations as follows: The south coast and the west coast of Iceland are washed by warm and salt Atlantic waters, its north coast by mixed waters and its east coast by cold and fresh polar waters.

III. The Plankton collected by the $^{S}/_{S}$ Hólar.

(Table I.)

A. Vestmannaeyjar and Hrolaugseyjar.

In these localities the plankton is very poor in spring; the most important forms are *Coscinodiscus* and *Chaetoceras decipiens*, — the latter is not wanting in any of the samples gathered in these places by the "Hólar". Species of *Thalassiosira*, especially *Th. gravida*, occur in the beginning of May, and a little later — apparently earlier at Vestmannaeyjar than at Hrolaugseyjar — we meet with *Asterionella japonica*, which maintains itself as the principal form till far on in June. The composition of the Asterionella-plankton is fairly constant. The most important species accompanying the principal species are *Chaetoceras debile* and *decipiens*, *Thalassiosira gravida* and *Nordenskiöldii*, *Coscinodiscus oculus Iridis* and *Skeletonema costatum*. Peridineæ and Tintinnidæ are sparingly represented. The Asterionella-plankton disappears at the close of July. The species of *Thalassiosira* continue a short time longer, then also disappear, and at the same time the summer Peridineæ make their appearance. This plankton remains, though decreasing in quantity, till the collections are discontinued in October. It must be designated as Longipes-plankton. *Peridinium ovatum* and *Ceratium longipes* occur in large quantities, and *Ceratium fusus* is more frequent than *C. furca*. *C. tripos* is without importance. Tintinnidæ, *Cyttarocylis denticulata* in particular, play an important part. The last sample (November 1st) was collected about ten miles S. E. of Ingolfshöfði, and has a southerly character. *Bacteriastrum varians*, *Dactyliosolen antarcticus*, *Rhizosolenia Debyana*, *Ceratium horridum* (v. *intermedium* Jörgs. = *C. Scoticum* Schütt), *Podolampas palmipes*, are all southerly forms, which during the summer-time are seldom or never found near Iceland.

B. Papey.

The samples collected here in early summer are characterized by Sira-Plankton: *Thalassiosira gravida*, *hyalina* and *Nordenskiöldii* both as to quantity and constancy predominate over all other forms. Their associates are somewhat variable; we may mention *Chaetoceras cinctum*, *debile*, *furcellatum* and *Wighami* (once in immense multitudes), *Rhizosolenia semispina*. The sample of June 13th is peculiar; it contains but few *Thalassiosira*, *Chaetoceras peruvianum* being the prevailing species. This and the following samples were collected at long. 13° 54′ W., about 5 miles further to the east than the other samples which were taken at long. 14° W. or even somewhat further to the west. As will be seen afterwards, in the open sea off the east coast of Iceland *Chaetoceras peruvianum* was prevalent, so we notice here how short a distance the Sira-plankton extends seaward. It is true the sample of July 2d still contains *Thalassiosira*, but also in considerable quantity *Chaetoceras peruvianum*.

In August, September and October we find near Papey a somewhat variable neritic Chaetoceras-plankton, in which *Ch. debile* and *Ch. decipiens* are prevalent, whereas *Ch. furcellatum*, *laciniosum* and *simile*, *Biddulphia aurita* and *Rhabdonema arcuatum* occur more or less scattered.

The last sample (October 31st) was taken west of Papey; its predominant species are *Corethron criophilum*, *Skeletonema costatum* and *Ptychocylis urnula*. It also contains a fair amount of species of *Ceratium*, which have been almost entirely wanting in the other samples. On the whole Peridineæ are of no importance near Papey; only *Peridinium islandicum*, *pallidum* and *pellucidum* occurred in somewhat considerable quantity (in August). The Tintinnidæ play an unimportant part in the Sira-plankton, but occur more abundantly at a later period. *Cyttarocylis denticulata* is probably the species appearing most regularly.

C. Digranes.

Some irregularity prevails as to the localities where the samples were collected by the "Hólar"; most of them were taken off Digranes, a few at Bjarnarey south of Vopna Fjord.

Here also we find Sira-plankton, but only in April. The other samples are all more or less poor. In July and August the principal forms are: *Chaetoceras decipiens, Ceratium arcticum, Peridinium ovatum, Dinophysis rotundata* and *Cyttarocylis gigantea.* None of these play any part in the sample of September, in which *Rhizosolenia styliformis* is the most prominent. At the close of October *Chaetoceras peruvianum* and *Corethron criophilum* occur in abundance.

D. Langanes.

The samples as a rule were collected north of Langanes. The Sira-plankton recurs here again in April. *Thalassiosira,* by the way, continues till up in July.

At the close of May *Chaetoceras peruvianum* begins to appear in large quantities, and about the middle of July it occurs in enormous masses. It is nearly always associated with *Rhizosolenia semispina,* and *Thalassiosira gravida* is wanting in none of the samples in which *Chaetoceras peruvianum* has its maximum. Among its assiocates we must notice *Chaetoceras diadema,* as this species forms part of all the Langanes samples taken in water with a low salinity (under 34 ‰). Though the samples were not collected at precisely the same point, but between latitudes 66° 20′ and 66° 27′ N., it has not been possible to find any connection between the locality of a sample and the salinity of its water, so we think we may assume that the samples exhibiting *Chaetoceras diadema* were taken in water which contains a large quantity of north-Icelandic coast-water, whereas the samples from salter water, in which no *Chaetoceras diadema* is found, proceed from more unmixed polar water.

Just as *Chaetoceras decipiens* was a characteristic of the samples from Hrolaugseyjar, *Ch. peruvianum* is distinctive of those from Langarnæs, and is wanting in none of them throughout the summer. In quantity, however, it decreases in July and August, whereas *Chaetoceras decipiens* has been gradually increasing until in August it became prevalent; subsequently it is replaced as principal form by *Rhizosolenia styliformis.* The latter disappears in September, at which season *Chaetoceras peruvianum* has its second and smaller maximum. At the close of October *Corethron criophilum* takes the lead.

At Langanes Peridineæ and Tintinnidæ are of slight importance; *Ceratium arcticum, C. longipes* and *Dinophysis rotundata* occur now and then in July and August in pretty great abundance. *Cyttarocylis gigantea* here as at Digranes, appears more frequently than *C. denticulata.*

E. Rödehuk.

The localities of the samples vary; most frequently they are collected west or south-west of Rödehuk, some of them, however to the north-east. The salinities are low, more so here than at Langanes; in both localities, however, they are below 34 ‰.

The Sira-plankton of April is unimportant; *Chaetoceras peruvianum* forms part of it. The maximum period of the latter is simultaneous with that of Langanes. *Chaetoceras diadema* also occurs here in samples of low salinity, if not so exclusively as at Langanes.

The maximum of *Chaetoceras peruvianum* suddenly discontinues, coinciding with a rise of surface-temperature in the course of eight days (from June 18th to 26th) from 4°,2 to 6° and simultaneously with the appearance of no small amount of Peridineæ *(Dinophysis rotundata, Goniodoma Ostenfeldii, Peridinium conicum, P. ovatum, P. pellucidum).* The Peridineæ continue, though somewhat variably, in all the following samples. *Chaetoceras decipiens* accompanied by *Cyttarocylis gigantea* obtains a small

maximum, with the interruption of a nearly diatomless sample of July 25th. In August *Rhizosolenia semispina* and *styliformis* make their appearance. September and October present a neritic Chaetoceras-Peridinium plankton, October moreover a slight occurrence of *Corethron criophilum*. The last sample (October 24th) contains mostly Peridineæ, but *Codonella ventricosa* prevails as well, thus characterizing it as highly neritic.

In its general features the plankton here resembles that of Langanes; the principal difference is the more frequent appearance of Peridineæ and Tintinnidæ.

F. Gjögurtá.

Here also the Sira plankton is but faintly developed; it does not appear till the end of May, contained in the maximum of *Chaetoceras peruvianum*, which culminates in the middle of June, but at the close of July *Chaetoceras peruvianum* is no longer important in the plankton, nor does it become so afterwards.

The sample of July 24th is almost devoid of diatoms — *Rhabdonema arcuatum* can scarcely be considered a genuine plankton form — and for the most part contains only *Peridinium ovatum*. This sample harmonizes well with that of July 25th from Rödehuk; the surface-temperature in both places is uncommonly low, whereas the salinities are rather higher than usual. Most likely the paucity of these samples is due to the fact that at this time the polar water has sent off a tongue to this place and killed the greater part of the organisms contained in the coast-water.

August presents a great multitude of plankton species, both diatoms and Peridineæ. *Chaetoceras cinctum, Ch. decipiens, Ch. Ingolfianum, Ch. laciniosum, Leptocylindrus, Rhizosolenia semispina, Skeletonema costatum, Heterocapsa triquetra, Peridinium ovatum, P. pellucidum, Amphorella subulata* are all present here, but none of them predominate. The following sample (October 13th) contains but few Peridineæ, and its principal forms consist of other species, such as *Ceratium longipes, Peridinium depressum*, and also to a certain extent of other diatoms, such as *Chaetoceras contortum* and *Ch. diadema*, besides *Ch. Ingolfianum*.

The samples of October are poor; like those of Rödehuk they consist for the most part of Peridineæ, but also contain many *Codonella ventricosa; Corethron criophilum*, however, is also present in noticeable quantity.

Here also at Gjögurtá the plankton-associations in their general features correspond with those of Langanes. Thus in early summer we find *Chaetoceras peruvianum* and in autumn *Corethron*, but the deviations are more considerable than at Rödehuk; *Chaetoceras decipiens* has disappeared as chief form, the Peridineæ and Tintinnidæ are more amply represented.

If we attempt in short outline to convey a general view of all the collections of the "Hólar", we can only find one feature which is common to all seven stations, viz. the more or less distinct occurrence of Sira-plankton in spring. It reaches its highest maximum and longest duration at Papey, its lowest maximum and shortest duration at Rödehuk and Gjögurtá.

To simplify the summary, we may divide the seven stations into three groups, viz.:

1) (Vestmannaeyjar and) Hrolaugseyjar.

In spring these stations are characterized by diatoms *(Chaetoceras decipiens);* in early summer by *Asterionella;* in late summer and autumn by Peridineæ *(Ceratium longipes, fusus, Peridinium ovatum).*

2) Papey.

Always characterized by diatoms; in spring and early summer: *Thalassiosira;* in late summer and autumn: neritic species of *Chaetoceras;* in October: *Corethron criophilum.*

3) Digranes, Langanes, Rödehuk and Gjögurtá.

In spring: *Sira*-plankton; in early summer: *Chaetoceras peruvianum*-maximum; in late summer: neritic *Chaetoceras*-species; in autumn: *Rhizosolenia styliformis* and lastly *Corethron criophilum*.

The plankton of all three groups is chiefly neritic, quite naturally, as the samples have been collected very close to the coast. The neritic character is most prominent in the second group (Papey), the only one in which we scarcely notice oceanic forms (see p. 6). Group 3 is the most varied and the most interesting. That the maxima of *Chaetoceras peruvianum*, which have been met with here, originate in the open sea, will be shown in a later page. The same may probably be said of *Rhizosolenia styliformis* and *Corethron*. The neritic forms probably proceed from the north coast of Iceland.

Gradually, in pursuing our course westward from Langanes, *Peridineæ* and *Tintinnidæ* become more frequent. We cannot deny the possibility that this may to a certain extent be due to the Irminger-current, whose eastern branch increases in power as it advances westward. More likely, however, this is not the case, as will be seen afterwards.

IV. The Plankton collected by the S|s "Thor".

Table II.

The "Thor" arrived at Seydisfjord on May 16th after having finished its quarterly cruises between Iceland and the Færöes, and it remained in Icelandic waters till August 4th. Its route will be found on the two maps, the first of which shows its route from the east coast southward and westward up to the north coast; the second indicates the return voyages. The maps also show the plankton-associations passed across by the "Thor" as well as their boundary-lines so far as it has been possible to indicate them.

As said above, a selection of samples has been grouped in tables; about those marked with an asterisk more information may be found in the supplementary list preceding the tables. This list also contains statements about zoo-plankton, for the most part gathered in Dr. Petersen's young-fish trawl by Dr. J. Schmidt.

About the plankton from the quarterly cruises in May and August, information is to be found in "Bulletin des résultats acquis pendant les périodiques, Année 1902—03, Supplément, Année 1903—04, No. 2": on Map I the boundary between the *Chaetoceras peruvianum*-plankton of the cold water and the *Ch. decipiens*-plankton of the Atlantic water, based upon the statements in the "Bulletin", is indicated.

A. East Iceland, May.

In May the east-Icelandic fjords were all filled with Sira-plankton (Table Nos. 1—2 and 4), which resembles the plankton we know from Papey, but it contains little or no *Chaetoceras decipiens*. The most important associates of the Thalassiosira-species are: *Chaetoceras furcellatum*[1]), *Ch. diadema* and *laciniosum*, *Bacterosira fragilis*. We scarcely meet with any Peridineæ at all, only in few specimens an undescribed species.

As stated above (p. 6), the Sira-plankton forms only a narrow stripe along the east coast of Iceland: No. 4 (Seley) has been gathered off Rödefjord and still contains pure Sira-plankton, *Chaetoceras peruvianum*, however, is common. Nos. 6—7 have been taken off Seydisfjord; they show that Sira-plankton is richest at the surface, whereas the deeper layers contain more *Chaetoceras peruvianum*. No. 8 (34,62 ‰ salinity) was taken at Station Da. Atl. 19, off Rödefjord, about four miles from the coast. No. 9 (34,79 ‰

[1]) If seen without spores *Chaetoceras furcellatum* and *Ch. cinctum* are very difficult to distinguish from each other.

salinity) at the same latitude about 45 miles off the coast (Station Da. Atl. 17); in the latter sample the Thalassiosira-species have disappeared.

It is worth noticing that a vertical haul at the position of No. 8, in a depth from 70 to 6 m. gave scarcely any *Thalassiosira*, which shows that here as at Dalatangi they are found in the surface-water only. It was different at a station (Da. Atl. 18) between the places 8 and 9, 23 miles off the coast; here the Thalassiosira-species only occurred in a depth of more than 75 m., a circumstance which could not be explained by the local hydrographic conditions. The occurrence of *Thalassiosira* in No 11, far out in the sea, may be attributed to melted ice-blocks.

We need only proceed a mile seaward from the east coast of Iceland to find that *Chaetoceras peruvianum* (*Ch. criophilum*) is the prevalent form. Its only important associate is *Rhizosolenia semispina*, and these two occurred east of Iceland in enormous uniform masses (Nos. 9—11); on its whole outward tour towards north-east, up to lat. 66° 09′ N., long. 10° 45′ W. the "Thor" met with nothing but this kind of plankton. The same plankton, though with a sprinkling of other forms, was met with at all cold-water stations passed by the "Thor" in May 1903, viz. at lat. 63° 36′ N., long. 6° 20′ W. (Da. Atl. 4, North of the Færöes), at lat. 64° 20′ N., long. 8° 37′ W. (Da. Atl. 10), and a very similar plankton, by the way, was found by the "Michael Sars" on its quarterly cruise at lat. 66° 58′ N., long. 8° 42′ W. (St. N. 19), at lat. 68° 12′ N., long. 12° 09′ W. (St. N. 14), at lat. 67° 28′ N., long. 10° 03′ W. (St. N. 15) (Bulletin).

This Chaetoceras peruvianum-plankton seems, therefore, to have filled up all the cold water of the Norwegian Sea in May.

B. South Iceland, June.

Of the samples collected by the "Holar" at Hrolaugseyjar we know the Asterionella-plankton of June. The voyage of the "Thor" showed it to be distributed as follows: from Eystrahorn in the east to about fifteen miles west of Skagi on Reykjanes; the "Thor" found it to extend furthest south on her western passage (to about 63° N.), on her eastern voyage the latitude it reached, was about 62° 10′ N. However, on account of the configuration of the Icelandic coast, the belt of *Asterionella* was broader to the east (ca. 90 miles) than to the west (ca. 60 miles).

As may be seen from the table (Nos. 12—15, 20—22), its composition is tolerably constant and nearly everywhere as at Hrolaugseyjar; *Coscinodiscus oculus Iridis* seems to be of less regular occurrence than we might suppose, judging from the samples of the "Hólar". *Nitzschia seriata*, on the other hand, appears more frequently than at Hrolaugseyjar, especially in the open sea. Peridineæ are present only in small quantities, the most frequently occurring is *Peridinium ovatum*.

Of organisms not indicated in the tables, but mentioned in the supplementary list, we note here *Coccolithophora pelagia* and *Clione borealis*. It has been shown by Ostenfeld and Paulsen that in 1899 the former was distributed throughout the whole northern Atlantic. The reason why it is not generally found is that the meshes of the nets are too large, thus allowing the small organisms to pass through. The "Thor", however, carried small nets of silk taffety; this stuff is so close, that it is no use pulling it through the water, but we only needed to pour a few buckets of water into the net to find the *Coccolithophora*, so densely did it occur. Unfortunately our silk taffety proved so fragile that it soon became quite useless.

Clione borealis was gathered in the young-fish-trawl by Dr. J. Schmidt almost everywhere south of Iceland, as well as east, north and west of the island. So we doubt whether Gran (Pl. norweg. Nordmeer.) is right in taking *Clione* as an arctic form and naming the arctic plankton-region after it.

The Asterionella-plankton, according to the lists published by Ostenfeld (Iagttagelser etc. 1898, 1899, 1900), has been found in previous years near the south-coast of Iceland at the following periods and places:

1897, April 29th, South of Reykjanes (here *Asterionella* was mentioned as being only of not frequent occurrence +),
June 10th, Round Vestmannaeyjar.
1898, June 3rd, South of Reykjanes.
„ 5th, South of Portland Head and South of Reykjanes.
„ 7th, Faxe-Bugt (Faxafloi).
„ 19th, South of Portland Head (Reijnis drangar) and South of Reykjanes.
July 17th, South of Portland Head.
1899, March 23nd, Off Reykjavik.
May 2nd, Round Vestmannaeyjar (very sparingly).
June 26th, South of Portland Head.

And according to lists worked out by the author, but still impublished,

1900, March 28th, South of Reykjanes.
April 26th, Round Vestmannaeyjar.
June 10th, In Faxe-Bugt.
„ 19th, In Skage-Fjord, at the North coast.

It goes without saying that the plankton of these localities does not always consist of the same organisms, yet we notice no slight degree of uniformity, as *Asterionella* is always found associated with a greater or smaller number of *Chaetoceras*-species (*Ch. debile, decipiens, cinctum, contortum, sociale*), frequently also with *Peridinium ovatum, Thalassiosira gravida, Th. Nordenskiöldii, Skeletonema costatum, Phaeocystis Pouchetii.*

From these statements we are justified in concluding — as already pointed out by Ostenfeld, Iagttagelser etc., 1900, p. 71 — that along the south coast of Iceland Asterionella-plankton recurs regularly every year in June and — at all events sometimes — in July. It is worth noticing that in 1899 and in 1900 it appears already in March, and in 1897 in April, all three times at the south-west corner of Iceland.

All the occurrences mentioned of *Asterionella* proceed from water which — with few exceptions — has a temperature exceeding 7° and a salinity of more than 35 ‰. The lowest temperature is 4°.4 (23nd April 1899), tho lowest salinity 34—37 ‰ (29th April 1897).

South of the domain of Asterionella-plankton we meet with another plankton-association, the principal forms of which are: *Chaetoceras pelagicum* (= *Ch. Ostenfeldii*, Cleve) and *Ch. Schüttii*, aff. (table Nos. 16—19). Besides these there are considerable quantities of *Chaetoceras decipiens, Cerataulina Bergonii, Nitzschia seriata, Rhizosolenia alata*, whereas the Thalassiosira-species have almost disappeared; Peridineæ are wanting.

This is the Oceanic Spring-Plankton of Ostenfeld (Iagttagelser, etc., 1898); it was found both on the southward-going (eastern) and on the northward-going (western) voyage of the "Thor" (see Map I). Of its principal forms *Chaetoceras Schüttii* already, though rarely, occurred in the domain of *Asterionella*, about 34 miles off Ingolfshöfdi; *Chaetoceras pelagicum* here indeed seems to be a metamorphosed *Ch. laciniosum*, we refer this question, however, to the systematic section of this treatise. At the furthest south-west station of this route (No. 18), the "Thor" suddenly found another plankton, the principal form of which is *Bacteriastrum delicatulum*, whereas there is a reduction in multitude of the Chaetoceras-species except *Ch. decipiens*, and Peridineæ play a more important part (*Ceratium furca, C. fusus, C. horridum, C. lineatum, Peridinium pallidum, P. pellucidum*). This plankton lives in warmer water than the oceanic spring-plankton; the surface-temperature was 9°.1, whereas at the nearest easterly station it was 8°.7, at the nearest northerly station 8°.5. As a similar plankton (Table No. 55) was found in July at the Vestmanna-eyjar, it seems reasonable to assume that it is this plankton which we met with on its course towards the north.

C. West Iceland, June.

From Reykjanes the "Thor" proceeded on its voyage in a nearly straight westward direction. Up to about fifteen miles west of Skagi the sea was full of Asterionella-plankton (Table No. 22), but further to the west there appeared a kind of Tricho-plankton with the principal forms: *Nitzschia seriata, Rhizosolenia gracillima* and *semispina*, and further containing in varying quantity: *Thalassiosira gravida, Thalassiothrix longissima, Chaetoceras cinctum* and *Ch. peruvianum* (Table Nos. 24—28).

The transition between the two plankton-associations was apparently not associated with considerable hydrographical changes; the water at Station 114 (Table No. 22) had a surface-temperature of 7°,63 and contained 35,07 ‰ salt, whereas the corresponding figures at Station 119 (Table No. 26) were 7°,70 and 35,14 ‰ respectively. At the transition we met with a huge maximum of *Thalassiosira gravida* (No. 24).

The occurrence of these two plankton-associations so close to each other here I would explain in the following way: Knudsen tells us ("Ingolf", Hydrography) that the waters on the two sides of the Reykjanes-ridge differ, especially in the depths, but also higher up, and that this difference disappears towards Reykjanes. According to his explanation, the waters — basin-water on the north side of the ridge, Atlantic water on the south side — flow in the direction of the ridge, but close to the Reykjanes-coast the Atlantic water is pressed from the south side across the ridge, and this southerly water carries with it the Asterionella-plankton, whereas the basin-water, which here, like the Asterionella-water, is of Atlantic origin, but has followed different courses and probably not touched the coast, carries Tricho-plankton with it.

At the place where sample No. 26 was taken (Station 119) a series of vertical hauls were undertaken with Nansen's closing-net; the deepest haul descended to 700 metres. All these collections exhibited the same plankton-organisms, but the deep ones only in small quantity, thus also the haul in a depth of 150—75 m. It was not till higher up, in a depth of 70—50 metres, that Diatoms abounded to such an extent as to give a brown colour to the water in the pail.

No noteworthy change in the composition of the plankton was found till we approached the East-Greenlandic ice, but even before it became possible to distinguish the ice through the fog, its vicinity revealed itself in the plankton. Thus if we compare the samples No. 27 and No. 28, which were collected at the same place, but the former at the surface, the latter at a depth of 200—55 m., we find the deep sample resembling those mentioned above, whereas in the surface one the Rhizosolenia-species are less frequent and *Thalassiosira gravida* has taken the lead[1]). *Phaeocystis Pouchetii* is common to both; while in the Tricho-plankton it was wanting. This station was only a few miles distant from the ice; strange enough, both its temperature and salinity were high (7°,65; 35,14 ‰). — Here we meet the mixture of Tricho- and Sira-plankton mentioned by Cleve (Phytopl. Atlant. p. 6), but there is scarcely any reason to assume — with Cleve — that the latter proceeds from Baffins Bay; on the contrary, the two following samples show it to originate at the borders of the ice. These samples (Nos. 29 and 30) were collected quite close to the Greenland-Ice and exhibit a maximum of *Thalassiosira* and *Phaeocystis*. Of Tricho-plankton organisms none remain in any abundance except *Chaetoceras cinctum*. Here close to the ice the surface-temperature is low, at the places where the samples (Nos. 29 and 30) were taken it was 2°,40 and 2°,28 respectively, whereas the corresponding salinities were 35,04 ‰ and 34,84 ‰.

The samples No. 31—34 have been gathered quite close to the Icelandic coast. No. 31 (the mouth of Önundarfjord) has a low salinity (ab. 33 ‰) and comparatively few *Thalassiosira* and no *Phaeocystis*. Evidently it is the fjord-water that produces the change at the surface; at a depth of merely 16—6 metres both *Thalassiosira* and *Chaetoceras cinctum* were frequent.

Önundarfjord itself was almost free from Diatoms; there were only a few *Fragilaria, Biddulphia,*

[1]) Gran (Norw. Nordmeer p. 135) mentions a similar vertical haul in Denmark Strait.

Licmophora, Hyalodiscus stelliger, and the only frequent forms were *Goniodoma Ostenfeldii, Tintinnopsis Karajacensis* var. *acuta, T. ventricosa* and *Medusae.*

Nos. 32—34, which are gathered more to the north, again show Sira-plankton; at that time Cape Nord, where No. 32 was taken, was closely surrounded by ice. We notice as a peculiar feature the abundant occurrence of *Chaetoceras debile* and the diminishing of *Phaeocystis* at the surface of Isafjord (No. 33), which on the whole contains a different plankton from that of the deeper layers. Here as everywhere in the mouths of the Fjords we find oceanic plankton in the depths, fjord-plankton at the surface.

On the route followed by the "Thor" on its outward passage west of Iceland, no information could be gathered at the time about the plankton in the northern part of Faxe Bugt (Faxafløi) and in Brede Bugt (Breiðifjörður). It would be natural, however, to suppose that Faxe Bugt at least was full of Asterionella-plankton, as such plankton was found on June 10th round Skagi and on July 2nd at Isafjord, besides, as stated above, having been found in June 1900 in Faxe Bugt. Moreover, it must be carried along by the Irminger-current from the waters south of Iceland, whose hydrographic conditions can scarcely be so different from those of the open Faxe Bugt as to prevent them from containing similar plankton, which, moreover, they are known to contain later in the year.

D. North Iceland, June—July.

At the western part of the north coast (Nos. 35—37) Peridineæ predominate (*Peridinium pellucidum* and others). Towards the east (Nos. 38—44) their quantity diminishes, and only *Goniodoma Ostenfeldii* and *Peridinium pellucidum* are present in all samples. This is also the case with *Chaetoceras peruvianum,* which is mostly associated with *Rhizosolenia semispina.* The eastern samples show a neritic Chaetoceras-plankton (*Ch. debile, diadema, furcellatum* as well as *Ch. decipiens* and *Ch. peruvianum*) which extend quite up to the inner coast of the long Öfjord (Eyjafjörður), in whose mouth Hrisey is situated.

Most of the samples have been taken quite close to the coast, but the sample from Grimsey (No. 41), where the surface-temperature was 3°,93 and the salinity 33,84 ‰, shows that the neritic Chaetoceras-species do not extend so far, though the neritic Peridineæ are found here.

Vertical hauls with the closing-net at Grimsey in a depth of 90—50 m. showed scarcely any but *Peridinium ovatum,* while vertical hauls at Brik Skær (Nos. 42—44) showed a larger quantity of Peridineæ at the surface, whereas *Chaetoceras peruvianum* occurred more frequently at a certain depth (50—30 m.).

No. 45 again has been taken at the western part of the north coast: — the diatoms have disappeared, and just as in the above mentioned western samples, the sample contains many Peridineæ and a certain amount of other forms, for instance *Ceratium arcticum.*

In comparing these samples from North Iceland with those of the "Hólar" from Langanes, Rödehuk and Gjögurtá, we find that the eastern samples of the "Thor" and those of June from the two last-mentioned places correspond well, but what is more significant — everywhere near the eastern part of the north coast *Chaetoceras peruvianum* appears as principal form, though more or less intermixed with neritic organisms. Therefore, in accordance with what has been stated in the hydrographic summary, we may assume that *Chaetoceras peruvianum* (and *Rhizosolenia semispina*) form the contribution of plankton from northern arctic waters, whereas the neritic organisms are endogenetic (*sensu* Aurivillii) along the eastern north coast of Iceland. The former supposition will not seem unreasonable when we consider the large extent of *Chaetoceras peruvianum* near East Iceland, and the latter forces itself upon us, as we do not find the neritic diatoms either to the west or to the north, and the nature of the currents forbids their coming from the east.

The plankton of the western north coast bears only to a certain extent the stamp of having been

carried thither from West Iceland, which otherwise one might have had reason to expect, as the Irminger-current sends a branch round Cape Nord; *Thalassiosira gravida* and *Chaetoceras cinctum* in particular, and perhaps *Phaeocystis Pouchetii* (Nos. 35—37) might very well have come from the ice-region close to Cape Nord, while others (most of the Peridineæ) do not seem to have arrived from the west, but rather to be endogenetic at Skagestrands Bugt (Húnafloi) and Skagefjord. They would indeed have difficulty in passing Cape Nord, where the sea is full of ice. Plankton may — as shown by C. G. Joh. Petersen — change very quickly in current water, but whether or how such a change has taken place here, is a question which the insufficient number of observations made till now does not allow us to decide definitely.

E. West Iceland, June.

From Cape Nord down to Bredebugt we find a neritic Asterionella-Chaetoceras-plankton which abounds in *Phaeocystis* and *Cyttarocylis denticulata*, but contains only a sparing number of Peridineæ. Probably the Asterionella-plankton has been carried by the Irminger-current from southern waters up to these regions and has mixed there with other forms. Ostenfeld tells us that a similar thing occurs with the summer Peridineæ-plankton which is carried up to Denmark Strait along the west side of Iceland (Iagttag. 1898, p. 71).

The sample from Bredebugt (No. 49) abounds in Peridineæ, and therefore might have been classed with the following divisions.

F. South Iceland, June.

In this division we have included several samples from the southern part of the west coast, because they belong to it from a plankton point of view. In these samples *Chaetoceras decipiens* predominates; it is associated with *Ch. furcellatum*, *Nitzschia seriata*, Peridineæ (*Peridinium ovatum* and *Gonyaulax spinifera* in particular) and *Cyttarocylis denticulata*.

No. 54 (south of Reykjanes) resembles these samples, but it has lost *Chaetoceras furcellatum* and *Nitzschia* and got *Coscinodisci* instead; it is very sparingly provided with Peridineæ; these (especially *Ceratia*) occur in considerable quantity in the next samples (Nos. 55—62), *Chaetoceras decipiens* being at the same time reduced to a secondary part in the plankton. This change coincides with a change in the hydrographical conditions: —

No. of the Sample	Surface-temperature	Salinity
50	10°,00	34,18 ‰
51	10°,35	34,05 ‰
54	9°,88	33,87 ‰
60	10°,50	35,21 ‰

The samples just mentioned of *Chaetoceras decipiens* have all been collected close to land, and so has No. 62, but not No. 63, yet it abounds in *Chaetoceras decipiens*. This might be explained by the fact, that the current of the coast water mixes with the water of Faxe Bugt, and that this coast water is very broad towards the east. That the samples of *Chaetoceras decipiens* at any rate bear a neritic character, may be seen from the associate species. The following organisms do not occur in considerable abundance except in samples characterized by *Chaetoceras decipiens*: *Chaetoceras furcellatum*, *Chaetoceras laciniosum*, *Nitzschia seriata*, *Ptychocylis urnula*, *Tintinnopsis karajacensis*, v. *acuta*. This is a predominantly neritic company.

The following organisms do not occur in large quantity except where *Chaetoceras decipiens* is rare (it is never entirely wanting): *Ceratium tripos, Ceratium horridum, Diplopsalis lenticula.* To these we may also add the following, which are far more abundantly represented in the last-mentioned samples: *Ceratium furca, Ceratium fusus, Dinophysis acuta, Cyttarocylis denticulata.* This is a predominantly oceanic company, which leads us to the conclusion, that plankton containing *Chaetoceras decipiens* is connected with or dependent on the coast.

The Peridineæ-plankton is somewhat less uniform than that of the samples collected in summer by the "Hólar" at Hrolaugseyjar, and it is less distinctly characterized as a *Ceratium longipes*-plankton than the latter. *C. furca, Peridinium ovatum* and *P. pallidum* are the most frequently occurring forms, but *C. fusus* occurs somewhat more regularly than *C. furca.* Neither *Ceratium tripos* nor *C. longipes* can be taken as dominating forms, whereas *Dinophysis acuta* plays an important part. The only Tintinnida of importance is *Cyttarocylis denticulata. Heterocapsa triquetra* was found in great abundance in a single sample (not indicated in the table) at Ingolfshöfdi.

Nos. 57—59 represent a series of vertical hauls with the closing-net, which show that nearly all organisms descend to a depth of at least 1000 m. The weather was calm and had been so for several days, so as to allow the organisms to sink. The hydrographic conditions here were as follows:

Depth	Temperature	Salinity
1900 m.	2°,75	35,03 ‰
1400 „	3°,60	34,29 „
1000 „	5°,20	35,01 „
800 „	6°,58	35,12 „ „

hence steadily rising to 10°,50 and 35,21 ‰ in the surface. As will be seen from the table, *Chaetoceras decipiens* occurred most frequently at a depth of more than 1000 m. in the layer where the salinity was lowest.

From the treatises of Ostenfeld of 1897, 1898 and 1899, and from my own lists of 1900 it appears that in these years as well as in 1904, Longipes-plankton ("Northern Peridineæ-plankton", Ostenfeld) has been found south of Iceland. It is frequently mixed with diatoms, e. g. in July 1899 with *Chaetoceras constrictum* and *Ch. decipiens, Ch. debile, Cerataulina Bergonii* etc.

It is only exceptionally, e. g. in August—October 1900, that Scotica-plankton, in which *Ceratium tripos* and *Peridinum divergens* predominated instead of *Ceratium longipes* and *P. ovatum*, was found south of Iceland. On the other hand, the plankton found in summer on the Greenland routes belonged to the Scotica-association. These voyages pass through more southern latitudes (58°—60° N.) and the surface-temperature and salinity are higher in those parts than further north near Iceland (comp. Wandel, Knudsen and Ostenfeld, Iagttagelser 1897, 1898, 1899, Surface-temp. of the Sea). Here, we may quote Cleve (Seasonal Distribution etc.): He gives the following average measures of temperature and salinity of some of the Peridineæ:

	Average temperature	Average salinity
1. Ceratium longipes.....	8°,4	34,02 ‰
2. C. tripos	11°,4	34,92 „
3. Peridinium ovatum	6°,4	34,06 „
4. P. divergens.....	15°,4	34,37 „

Though in many cases Cleve's average-measures are of no great value, as they are derived from too few observations, the figures given here are useful in so far as they illustrate the fact that No. 1 and No. 3 occur in colder and fresher water than No. 2 and No. 4.

G. East Iceland, July—August.

At the end of July the boundary between the warm and the cold water lies between the samples Nos. 64 and 65 close to Vestrahorn; at the position of No. 63 the surface-temperature was 11°,45, at that of No. 65: 6°,91 and somewhat more to the north, at lat. 64°, 34′ N., long. 13° 55′ W. only 4°,3.

From the Peridineæ-plankton we pass into a tract of Sira-plankton which very much resembles that of the Papey-sample of ihe "Hólar", July 12th; it is a mixture of *Thalassiosira, Rhizosolenia semispina* and *Chaetoceras cinctum.*

The samples of the "Hólar" show that the *Thalassiosira*-species continue till quite up to the close of August at Papey, but not, for instance, at Digranes, and at the northern part of the east coast the "Thor" found no Sira-plankton.

I am of the opinion that this Sira-plankton of the southern east coast is a mixed area plankton, as it occurs in places where cold and hot water meet and blend. Ostenfeld (Iagttagelser 1899, p. 64) and Gran (Norweg. Nordmeer p. 116) point out that mixed areas are often particularly rich in plankton.

Outside the Thalassiosira-area the coast plankton of the east coast at this season is a diatom-plankton, the most important forms of which are: *Leptocylindrus danicus, Chaetoceras cinctum, debile, decipiens, diadema, furcellatum, laciniosum, Rhizosolenia semispina.* Among the Peridineæ there are no *Ceratia*, but *Gonyaulax triacantha*, and species of *Peridinium* (*P. pallidum, subinermis, roseum*), a sprinkling of *Glenodinium bipes* and others.

No. 70 was collected only about seven miles off the coast in water with a salinity of ca. 34 ‰; it consists of almost pure Peridineæ-plankton (*Ceratium arcticum, Dinophysis rotundata, Peridinium islandicum, P. ovatum*). No. 71 (Da. Atl. 18) and No. 72 (Da. Atl. 17) show that the Peridinium-species decrease in going seaward. And in the open sea *Ceratium arcticum* is the principal form in the cold water, just as *Chaetoceras peruvianum* was predominant in May and June.

The plankton gathered by the "Thor" during its quarterly cruises to and from Iceland has been published in "Bulletin des rèsultats acquis, etc.", Année 1903—04, No. 2. In the polar water *Ceratium arcticum* was found everywhere as the principal form in August. The same observations were made by the Norwegian quarterly cruise at| that period (Station: NN. 13: lat. 66° 55′ N., long. 8° 48′ W.; Station: N. 46: lat. 65° 04′ N., long. 11° 16′ W.) though at the first mentioned station *Chaetoceras peruvianum* preponderated. The southern boundary of the Ceratium-arcticum-plankton is marked on map II. In the Atlantic water other Peridineæ (*Ceratium tripos, fusus*, etc.) predominated.

The Stations Da. Atl. 8, 13, 14, 15 and 16 are specially mentioned here because (with maximum at 8 and 14) they showed an abundance of a small spore-less *Chaetoceras* which I have named *Ch. cinctum.* It is not unreasonable to suppose that this plankton also belongs to a mixed area, the salinities being tolerably low, at some of the stations below 35 ‰ (see Bulletin, Août 1903, Année 1903—04, No. 1).

V. Plankton in Fjords where Whaling-Stations are.

In my instructions given by Mr. C. H. Ostenfeld, the director of the Danish Plankton Investigations, I was desired to examine the plankton in fjords where whaling-stations are found.

With this object in view I have undertaken horizontal hauls of a certain duration — generally five minutes — partly in the immediate vicinity of the Whaling-Stations, partly, by way of comparison,

hauls of the same duration in other places of the same fjord or in other similar fjords. The opening of the net had a diameter of 28 cm. and it was trailed at the "Thor"'s lowest speed, "dead slow". The samples were carried home, and the volumes of the plankton were measured after the samples had been allowed to stand untouched for at least a week. The measuring consisted in pouring water into the glasses so as to make it fill up the same space which had been occupied by the plankton, and then to measure this water.

I give here the result of the measuring of the samples.

Date	Locality	Volume
May 26th	Head of Mjói Fjord, at BERG's Whaling-station	15,7 ccm.
„ 29th	Head of Eske Fjord (no Whaling-st.)	1,6 ccm.
„ 30th	Head of Faskruðs Fjord (no Whaling-st.)	4,4 ccm.
Aug. 3rd	Mouth of Faskruðs Fjord, at the newly-opened Whaling-st.	1,1 ccm.
—	Head of Faskruðs Fjord	4,4 ccm.
Aug. 13th	Færöes, at Lopra Whaling-station, head of Vaag Fjord	4,9 ccm.
—	Mouth of Vaag Fjord	1 ccm.

The figures show at any rate that the presence of a whaling-station does not seem to diminish the quantity of the plankton. Whether the reverse is the case may be open to doubt, as the whaling-stations are often situated in particularly sheltered places, where the water is calm (for instance, BERG's station), and the wealth of plankton may be due to this circumstance.

In the composition of the plankton I have been unable to discover any important feature indicating that a change in it might have been produced by the whaling-station. The first three samples consist of Sira-plankton, the next two of neritic Chaetoceras-plankton, just as we might expect from the seasons. We enumerate here the samples from the Færöes:

	Lopra Whaling-Station	Mouth of Vaag Fjord
Chaetoceras cinctum	—	...
— constrictum	+	r
— contortum	c	r
— debile	c	+
— decipiens	+	r
Coscinodiscus sp.	...	rr
Lauderia borealis	...	rr
Leptocylindrus danicus	+	rr
Nitzschia seriata	+	...
Paralia sulcata	...	r
Rhizosolenia Faeroënsis	...	rr
— styliformis	—	—
Skeletonema costatum	+	..
Thalassiosira gravida	cc	+
— Nordenskiöldii	cc	+
Thalassiothrix Frauenfeldii	+	...
Ceratium longipes	...	rr
Peridinium pallidum	...	r
— pellucidum	...	r

	Lopra Whaling-Station	Mouth of Vaag Fjord
Amphorella subulata	+	...
Cyttarocylis gigantea	...	rr
— norvegica	rr	...

In my opinion the difference between the samples is sufficiently explained by the fact that the latter has been gathered at the mouth, the former at the head of the fjord, whence it follows that the latter is richer and more neritic.

VI. Survey of the Plankton-Associations and their mutual Relations.

During the seasons of the year when collections have been made, we have noticed the following periodic changes in the plankton south of Iceland:

I. Disco-Plankton in early spring.
II. Asterionella-Plankton in early summer.
III. Longipes-Plankton in late summer & autumn.

We have some reason to suppose that shoals of these plankton associations are carried up one by one along the west coast of Iceland in a somewhat narrow strip, whereas in June the "basin-water" of Denmark Strait possesses a Tricho-plankton of its own, which close to the ice is replaced by a Sira-plankton.

It is worth noticing, 1° that, corresponding with the hydrographical conditions, the boundary line of the plankton-associations at the south-east coast of Iceland seems to be very distinctly marked; 2° that we do not at the southern as at the eastern coast, meet with a narrow strip of neritic plankton, but that the plankton-associations present there extend, essentially unchanged, from the coast far out into the open sea. This applies both to the Asterionella-plankton, which in its composition may be called chiefly neritic, and to the Longipes-plankton which is chiefly oceanic.

At the east coast on the contrary, as mentioned before, we find a narrow strip of neritic plankton, which disappears in the immediate vicinity of the coast, where it is replaced by an oceanic association.

The difference between the southern and the western coast is easily explained, if we assume that the East Icelandic polar current moves rather quickly, while there is very slow or practically no movement in the sea south of Iceland[1]). If this be the case, the neritic plankton of the east coast, which lives and multiplies in the fjords, must at the mouths be carried away southward — we may also here bear in mind that the Sira-plankton remains longer at the southern part of the east coast, — while the neritic plankton at the south coast will be carried from the coast further and further seaward by surface currents.

At the east coast we have made acquaintance with the following plankton-associations (perhaps there have been more than we know of):

[1]) According to the records of Ryder, the average speed of the current at the east coast (in 1902) was ca. 4,22 miles in 24 hours, at the south coast ca. 3,2 miles, but his figures are too few in number and are not of great importance, because, as he points out himself, the bottles may have floated a long time before they were found.

Neritic: Sira-plankton, in early summer.
Leptocylindrus-Chaetoceras-plankton, in late summer.

Oceanic: Chaetoceras peruvianum-plankton, in early summer.
Ceratium arcticum-plankton, in late summer.

The August-maximum of *Chaetoceras decipiens* at Langanes must be of neritic origin, comp. the above statements of this organism (p. 14).

We know too little about the conditions at the north coast; they seem to be more complicated. We have seen that *Chaetoceras peruvianum*, which in all probability originates in polar water, predominates in the coast plankton at the eastern part of the north coast till into July. The eastern oceanic plankton of August *(Ceratium arcticum)*, on the contrary, does not form a noticeable feature in the coast plankton (at rare intervals tendencies hereto have been noticed at Langanes and at Digranes). Thus in August, the plankton of the eastern north coast does not seem to be essentially influenced by cold oceanic currents; whether the reason thereof is, that in later summer the eastern branch of the Irminger-current has gained more power — the ice must have moved further away — may be left an open question. However, in speaking of the summer 1903, the effect of the Irminger-current on the plankton of the north coast seems doubtful to me. Perhaps the Peridineæ-plankton at Gjögurtá may have come from the west and the south, thus being a diluted and changed Longipes-plankton, but, as said before, Peridineæ to some extent the same forms as at Gjögurtá — were found at the western part of the north coast, while Cape Nord was still blocked up with ice.

The maximum of the *Rhizosolenia styliformis* occurring in August at Langanes, Rödehuk and Digranes, and the maximum of the *Corethron criophilum* found in October (in varying quantities) at all the stations of the "Hólar" must — according to our knowledge about the currents — be supposed to proceed from the north, and the last-mentioned must have been brought by a current powerful enough to penetrate quite in to the coast; so then we again meet with oceanic plankton-organisms at the eastern part of the north coast.

Through further researches in 1904 we may hope to obtain a more exact knowledge of many conditions which are still unexplained, and until ampler information is at hand, the author intends to postpone the treatment of the Icelandic plankton from a wider biological point of view.

VII. Systematic Remarks on some Plankton-Organisms.

Chaetoceras cinctum Gran. As already observed by Gran (Norw. North-Atl. Exp. p. 25), this species and *Ch. furcellatum* are difficult to distinguish from each other without spores. So the indications in the tables are scarcely quite reliable except where the cells contain spores.

In living specimens of *Ch. cinctum* the protoplasm is frequently seen coming out of the cells. No doubt it comes out between the valves; in a single case I saw the valves part, as if the body had been pinched (which may indeed have happened under the glass cover). As a rule, however, the cells are apparently quite unhurt. I have seen a lump of dumbbell-shaped protoplasm, one half outside, the other half inside the cell; now and then we may also find the protoplasm in a shapeless lump without membrane lying close by the empty cell. This may possibly be due to the confinement under a glass-cover, but if

so, the effect must be produced rapidly indeed, for the phenomenon may be observed as shortly after the haul as the time taken to place the organism under the cover.

Chaetoceras laciniosum Schütt, is a neritic diatom of common occurrence round the Icelandic coasts. It resembles, as we know, *Ch. pelagicum* Cleve (*Ch. Ostenfeldii* Cleve), which is slenderer and has but one chromatophore; it might even be presupposed, as suggested by Ostenfeld (Iagttagelser, 1899), to be a starving form of *Ch. laciniosum*. The following observations may throw some light on the question. On June 1st, when the "Thor" found itself south of Iceland and was sailing from Ingolfshöfði in a S.E. to S. direction, I found in the Asterionella-plankton, which also contained *Ch. laciniosum*, the first specimens of *Ch. pelagicum*, which became predominant further to the south. An examination of *Ch. laciniosum* in this place revealed that some specimens had two chromatophores remote from each other, others had two situated close up to each other, or only one which was contracted in the middle. From this last stage there is but one step to *Ch. pelagicum*.

Chaetoceras Wighami Btw. This little diatom was met with once near Papey in great abundance. It had no spores, but as it corresponded in other respects with the figures of Brightwell and Gran (Norw. N. Atlant. Exp.), I have used for it the name of *Ch. Wighami*.

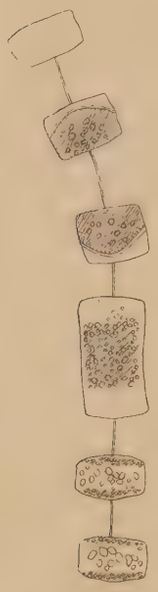

Fig. 1. Thalassiosira gravida Cleve.

Rhizosolenia Debyana Perag. This name represents the same organism which is mentioned by Ostenfeld and Paulsen (l. c. p. 162) under the name of *Rhizosolenia sp.* The chromatophores are almost punctiform. It has been found only at very rare intervals S.E. of Ingolfshöfði.

Rhizosolenia hebetata Bail. Gran states (Bulletin, Février 1903 p. 163) that *Rhizosolenia semispina* is only a summer form of *Rh. hebetata*. As some notice about this subject is no doubt to be expected, I will only say that I too have observed that the characters of both these two species may be found in the same individual.

Thalassiosira gravida Cleve. In chains of this species we sometimes find large thin-walled cells containing a granular substance, which does not fill the whole cell (fig. 1, from Denmark Strait). The varying appearance of these cells is probably due to a parasitic organism. Two of the cells in the figure show the beginning stage of the formation of resting spores, a figure resembling that of "*Melosira alternans*" drawn by Pouchet, which is a corresponding stage of *Thalassiosira Nordenskiöldii*.

Goniodoma Ostenfeldii n. sp. (*Glenodinium Ostenfeldii* nom. nud., Bulletin des résultats acquis, etc., Nov. 1903, Plankton-Species, Nr. 64, p. 68). Proximal limb of the cell nearly hemispherical; frontal side somewhat depressed. Distal limb very bluntly conical with convex outline. Girdle forming a gently ascending spiral to the left (botanically: to the right). Longitudinal furrow short, sometimes shorter and narrower than in fig. 2 a. Membrane thin, transparent, not areolated and apparently without plates; but a strong treatment with muriatic acid reveals its division into plates; these, however, are difficult to discern, as the membrane is apt to shrink on account of its thinness. The arrangement of the plates is seen in fig. 2, e (antapical view) and f (apical view). The bottom of the girdle is formed of one plate. Length 48—60 μ.

When alive the contents are dense, yellowish brown. They are often seen coming out in a globular mass, the distal limb detaching itself. We may also find individuals in which the contents have divided

while the cell was still moving freely (fig. 2, g). This state greatly resembles that of a *Peridinium* figured by KLEBS (1883, tab. II, fig. 23).

In 1903, *Goniodoma Ostenfeldii* has been found at many places along the northern and eastern coast, from Önundarfjord to Berufjord. It seems to be a northern neritic form.

This species is included in the genus *Goniodoma*, because the plates are arranged as in this genus. At first I took it for a *Glenodinium* on account of its shape and apparently simple membrane, and because fig. 2, e vaguely resembles fig. 4 of KLEBS (1884, tab. X) which presents an antapical view of *Glenodinium trochoideum*, the two bottom plates, in particular, situated close to the longitudinal furrow, seemed to me quite like those of the figure of KLEBS. The lines in this drawing can hardly be supposed to represent sutures, they are more likely prominent ridges which, as we know, frequently follow the course of the sutures.

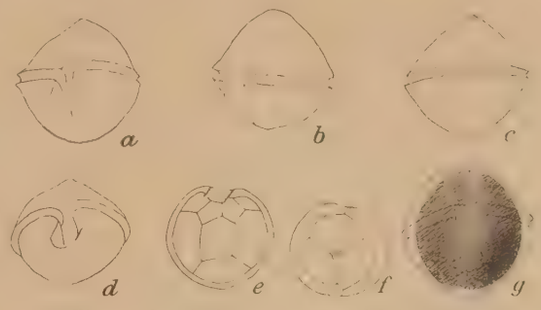

Fig. 2. Goniodoma Ostenfeldii n. sp.

It appears to me that the species of the genus *Glenodinium* have been insufficiently examined. If, for instance, in one specimen of *Gl. uliginosum*, SCHILLING (l. c. p. 11) found the valve areolated („Täfelung der Hülle"), it seems most natural to assume that sutures may be detected in other specimens as well. In 1883 KLEBS declares that the valves of the freshwater-species of *Glenodinium* are always composed of plates, but in 1884 he admits that some pelagic forms of *Gl. trochoidium* have a perfectly smooth membrane, and that others are striped or reticularly thickened (l. c. tab. X, figs. 1—5). But, as SCHÜTT quotes, KLEBS does not make the necessary distinction between stripes or thickenings and sutures connecting plates. — And if *Goniodoma Ostenfeldii*, which in certain respects resembles *Glenodinium*, can scarcely be assigned to this genus as it is at present characterized, it seems natural to suppose that closer investigations will reveal the necessity of rediagnosing the genus *Glenodinium*, if not of dropping it altogether.

The species has been named after Mr. C. H. Ostenfeld, with whom I have consulted about this and other organisms mentioned in the present work.

Glenodinium bipes n. sp. Cell somewhat compressed, dorsal or ventral view pentagonal, forming one acute and four obtuse angles. The distal limb is corniculate, just as in *Ceratium furca;* to each of the two angles of the proximal limb a thin, solid spine is attached. The girdle forms a gently ascending spiral to the right (in botanical terminology, to the left). Longitudinal furrow short and indistinct. Membrane thin, uniform, without visible structure or sutures. Length 35 μ, antapical spines included. (Only one specimen was measured.) About its colour I regret to be unable to give information.

Fig. 3. Glenodinium bipes n. sp.

I found this organism at the following places of the Icelandic coast: Skagi (on Reykjanes), July 10th, in horizontal hauls; Gjögurtá, August 15th ("Hólar"); Papey, Aug. 1st ("Hólar"), consequently: at the west, north and east coast. Mr. OSTENFELD tells me that it has been found also further out in the North-Atlantic, viz. 58° 11′ Lat. N., 29° 38′ Long. W., May 15th, 1903 and 60° 19′ Lat. N., 30° 20′ Long. W., June 14th, 1903. It always occurs in very small numbers, and being of diminutive size, is probably often overlooked or may have passed through the meshes of the net.

Fig. 4. Glenodinium bipes n. sp., var.

Fig. 3, a, b, c gives three views of a specimen. Fig. 4 is a closely related form with indistinct girdle. It was collected in May at Vestmanhavn in the Faeröes.

Gonyaulax triacantha E. Jörgensen, Bergens Museums Aarbog, 1899, VI, p. 35; *Ceratium* (?) *hyperboreum* Cleve, Notes, Atl. Plankt. Organisms, 1900, Pl. VIII, fig. 14. Paulsen in "Bulletin des resultats etc. Nov. 1903, Nr. 53.

E. Jörgensen (l. c. p. 35) has described a Peridinea from the west coast of Norway (Herlö Fjord) of which he has seen only a few specimens, and which he has reluctantly named *Gonyaulax* as he has not been able to see the arrangement of the plates. Shortly after, Cleve has given a short description and a rough figure of a Peridinea, which he names *Ceratium* (?) *hyperboreum* and which has been found in plankton from Spitsbergen. Through the kindness of Mr. Jörgensen I have convinced myself that the two descriptions belong to the same species and consequently the species in question must bear the name given by Jörgensen.

Near Iceland I have found a form which I consider identical with the species of Jörgensen and Cleve; and as I have succeeded in seeing the arrangement of the plates I am able to give a more exhaustive description and better figures of it (fig. 5). The outline of the cell is about the same as in Cleve's figure; the distal limb is prolonged in a horn, its sides are concave, the proximal limb is provided with two large and several small spines; the membrane is reticulate (this is only drawn in fig. 5 a). There is this difference, however, that in Cleve's figure the girdle twists to the left (botanically to the "right"), in mine the reverse, and that in Cleve's drawing the largest spine stands to the right, in mine to the left. I do not, however, attach great importance to this; Cleve may possibly have drawn his figure from an empty valve, so that he drew the ventral side though the dorsal side turned upward, and this, of course, would reverse the position.

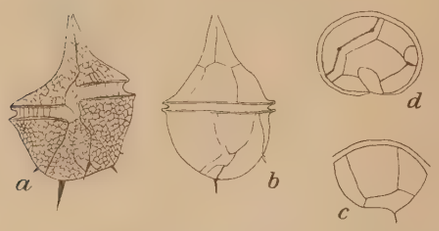

Fig. 5. Gonyaulax triacantha Jörg.

The sutures are not easily distinguished on account of the dense contents and the close reticulation. Fig. d, which is seen in antapical view, shows that there is only one bottom-plate, and also that some of the spines are connected by a ridge (drawn in double outline). Fig. c represents the proximal limb of the cell from the dorsal view, fig. b the whole cell in lateral view.

The longitudinal furrow proceeds upward along the apical horn. This feature, as well as the presence of only one bottom-plate necessitate the assignment of the species to the genus *Gonyaulax*. Length 72—84 μ; Cleve notes 70 μ.

Gonyaulax triacantha has only been met with at the north and east coast of Iceland, most abundantly in autumn in the fjords on the east coast. So we must agree with Cleve in considering it as a northerly neritic form. Besides, according to letters from Ostenfeld and Levander, it has been found on rare occasions in Danish waters, in the northern Baltic and (according to Ostenfeld and Paulsen) N. W. of the Shetland Isles. Recently also in Trangisvaag Fjord, the Færöes.

That the membrane of *Gonyaulax triacantha* is areolated while that of other species of *Gonyaulax* is poroid (Schütt l. c. p. 14) does not seem to me to be of essential importance in determining the genus. For, according to Schütt, poroids are only a special development of areols; besides, Ostenfeld and Schmidt (l. c. p. 172) have described a species (*G. hyalina*) of *Gonyaulax*, which is provided with very fine areols ("finely striate").

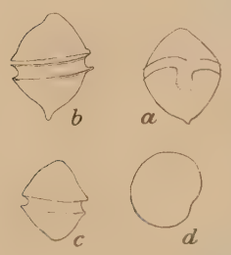

Fig. 6. Heterocapsa triquetra (Ehbg.) Stein.

Heterocapsa triquetra (Ehrbg.) Stein, l. c. tab. 3, figs. 30—40. Schütt l. c. tab. 21, fig. 62.

Of this little Peridinea we give a drawing (fig. 6) which shows that its Icelandic form is somewhat shorter and thicker than the form hitherto figured. The contents are brown, and, as illustrated both by Stein and Schütt, are frequently seen coming out of the valves; fig. 6, b shows the upper valve detaching itself. The longitudinal furrow (fig. a) is very indistinct. The sutures, as a rule, are not visible in the living organisms. Fig. d is seen in the antapical view.

Heterocapsa triquetra has been found both at the south coast and at the north coast of Iceland (Gjögurtá, the "Holar"), more, however, at the south coast, and in greatest abundance at Ingolfshöfði, July 19th.

Peridinium islandicum n. sp. Cell depressed and oblique; frontal view (fig. 7, a) and lateral view (fig. 7, b) nearly rhombic, apical and antapical views (figs. c—e) almost circular. The girdle forms a gently ascending spiral to the right (botanically "left"). Longitudinal furrow short and broad; at the bottom of its right margin one spine, at its left margin two, one of which has a wing on one side (figs. a, e; × represents the wing). Right margin of longitudinal furrow sharply denticulate (figs. d, e). The arrangement of the plates is seen in figs. c, d. Length (from apex to extremity of spines) 56—64 μ. Diameter 68 μ (only one specimen measured). Chromaphores yellowish brown.

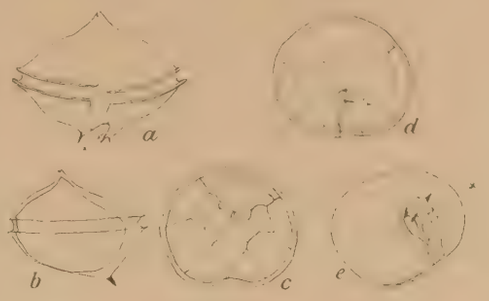

Fig. 7. Peridinium islandicum n. sp.

This species has been found at the north and the east coast of Iceland and only once at the south coast (Hrolaugseyjar). In a sample from Stat., N. 42 (Lat. N. 63° 35′, Long. W. 3° 36′) August 1903, I have also seen specimens of it. It seems to be a northern neritic form belonging to late summer.

Peridinium ovatum (Pouchet) Schütt. Fig. 8 represents the antapical view of a specimen, whose longest diameter is 84 μ. It was collected at Grimsey, July 30th. The illustration is meant for comparison with the subsequent species. We see that the spines proceed at equal distance from the longitudinal furrow and are connected by a membranous ridge.

Fig. 8. Peridinium ovatum (Pouchet) Schütt.

Peridinium roseum n. sp. Frontal view of the cell nearly rhombic (fig. 9 a) with projecting apex; antapical view broadly oval (figs. b, c), girdle a gently ascending spiral to the right (botanically "left"); longitudinal furrow broad. Close to, but not touching the lower end of the longitudinal furrow, are situated two spines, of which the one most to the right is furthest removed from the furrow (figs. c, f). In the middle of the proximal part of the longitudinal furrow we see a winged membranous ridge, and this wing almost appears like a third spine (figs. a, d, e). The arrangement of the plates is seen in figs. b, c. In antapical view we only discern an indication of the suture connecting the two antapical plates. When alive the colour is rosy, just as in *Peridinium ovatum*. Length, without spines, 60 μ (one specimen only was measured).

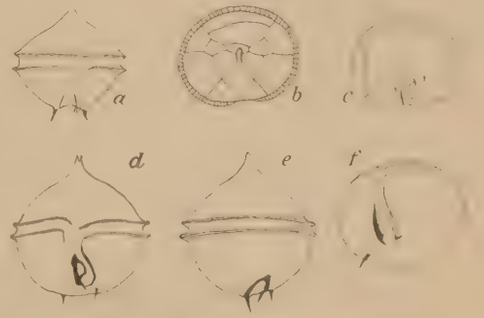

Fig. 9. Peridinium roseum n. sp.

This species has been found only at the north and east coast of Iceland, and most frequently in late summer. I have also seen it in Skjellevik Fjord at the mouth of Hardanger Fjord, March 30th, 1904. Further Mr. Ostenfeld has found it at 59° 23′ Lat. N., 48° 31′ Long. W., June 20th, 1903 and at 58° 26′ Lat. N., 39° 44′ Long. W., July 22d, 1903. Like *Peridinium islandicum*, it is an arctic neritic form.

Figs. 9 a, b, c represents a specimen from Beru Fjord, figs. d, e, f one from Grimsey. Though they differ a little in appearance, I have no doubt that they belong to the same species, for I have seen many specimens of it. The difference to a certain extent is due to the fact that fig. d, is seen more in the ventral view than fig. a.

Peridinium roseum somewhat reminds us of *P. ovatum* but is higher and narrower, besides being distinguished by its wing in the longitudinal furrow and by the position of its spines (comp. fig. 8 with fig 9,

c and b, the two figures are drawn with the same magnification, $^{460}/_{1}$). Our species also resembles *Peridinium sp.* figured by GRAN (Pl. d. norw. Nordmeeres, fig. 13). Mr. GRAN, whom I consulted in this matter, does not think these two species identical. His *Peridinium sp.* distinguishes itself by marked asymmetry and by the long distance of the antapical spines from the longitudinal furrow.

Peridinium subinermis n. sp. Front view of cell approximately square, with the bottom angle cut off. Girdle a gently ascending spiral to the left (botanically: to the right). Longitudinal furrow short; at its margins two fine spines (fig. 10, a) are, and below it, at the antapical margin of the depression that surrounds it (figs. c, d) we find two membranous thickenings (black in fig. c) which may take the shape of two small spines (fig. a). These spines are sometimes wanting, sometimes larger than drawn in fig. a. The arrangement of the plates is seen in figs. a—c. Length 60—65 μ.

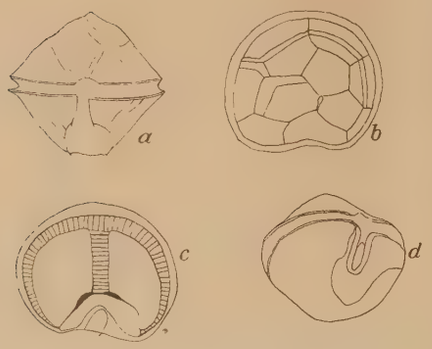

Fig. 10. Peridinium subinermis n. sp.

This species has been found in Beru Fjord, East Iceland, and also in Davis Straits by the s/s "Godthaab", at 60° 41′ Lat. N., 53° 34′ Long. W., in July 1900; also Mr. OSTENFELD has seen it in July 1903 (58° 26′ Lat. N., 39° 44′ Long. W. and 58° 8′ Lat. N., 35° 21′ Long. W.).

Peridinium subinermis is closely akin to *P. pentagonum* Gran (Pl. d. norw. Nordmeeres, p. 190, fig. 15), from which it is distinguished by a more spherical shape and by showing uniform lateral development, so that the antapical view does not present an irregular reniform figure.

Peridinium decipiens Jörgensen (l. c. p. 40), Gran (Pl. d. norw. Nordm. fig. 12).

We present here a drawing (fig. 11) of a specimen from Skialfandi (north coast) of a form of this species. The figures show more distinctly than those of GRAN that the girdle forms a spiral to the left (botanically to the right). JÖRGENSEN describes his species as "flat, almost cake-shaped", which does not agree with GRAN's figures or mine; our form is higher than *Peridinium ovatum* (both GRAN's figures and the specimens I have seen). See also *Peridinium decipiens* var. (?) *curvipes*, Ostenfeld, Phytopl. Faeröes, fig. 128. The form here mentioned I have met with but rarely, at the north and west coast of Iceland.

Fig. 11. Peridinium decipiens, Jörg. (?)

Fig. 12. Tintinnopsis karajacensis, Brandt. var. acuta n. var.

Tintinnopsis karajacencis, Brandt, l. c. fig. 5; Vanhöffen l. c. tab. V, fig. 22.

Var. **acuta** n. var. (fig. 12) differs from the main form in being acute at the closed end of the case. Common in the fjords and close to the coast in all waters surrounding Iceland.

VIII. Supplementary List to the Tables.

In the following list we mention the rarely occurring species which are not enumerated in the tables, as well as several species which are found in samples not enumerated in the tables, but which have been collected at places between the places of the enumerated samples or with other collecting-methods.

Samples of the "Hólar".

(Table I.)

A. Vestmannaeyjar.

15. IV.[1]) Foraminifera rr.
16. V. Cerataulina Bergonii rr, Coccolithophora pelagica rr.

A. Hrolaugseyjar.

17. IV. Pterosperma Moebii rr.
7. V. Undella caudata rr, Pterosperma Moebii rr.
18. V. Chaetoceras boreale rr, Coccolithophora pelagica rr.
1. VIII. Ceratium macroceras rr.
9. VIII. Xanhidium hystrix rr.
29. VIII. Rhizosolenia setigera rr.
6. IX. Peridinium globulus, aff. rr.
6. X. Coscinodiscus subtilis rr, Peridinium globulus, aff. rr.
1. XI. Cerataulina Bergonii rr, Chaetoceras skeleton rr, Ch. Schüttii r, Rhizosolenia alata f. curvirostris +, Rh. Shrubsolii r, Roperia tesselata rr, Thalassiosira subtilis rr, Peridinium pedunculatum rr, Pterosperma dictyon rr, P. Moebii rr, Coccolithophora pelagica rr, Dictyocysta elegans rr, Codonella pusilla rr.

B. Papey.

7. V. Foraminifera rr.
12. VII. Peridinium subinermis rr.
1. VIII. Glenodinium bipes rr, Leprotintinnus pellucidus rr.
26. IX. Coscinodiscus subtilis rr, Licmophora sp. rr.
1. XI. Roperia tesselata rr, Undella caudata rr.

C. Digranes.

31. V. Licmophora sp. rr.
20. IX. Thalassiothrix longissima rr.
11. X. Diploneis sp. rr.
26. X. Protocystis (Challengeria) tridens rr.

[1]) The figures denote day and month for the collecting, e. g. 15. IV. means the 15th of April.

D. Langanes.

1. V. Coscinodiscus subtilis rr.
27. VI. Peridinium roseum rr.
16. VII. Peridinium subinermis r, Hexasterias problematica rr.

E. Rödehuk.

24. V. Hyalodiscus stelliger rr.
18. VI. Peridinium spinosum, aff. rr.
26. VI. Peridinium roseum r, Phalacroma minutum rr.
22. VIII. Peridinium decipiens rr. Gonyaulax triacantha rr.
24. X. Coscinodiscus subtilis rr, Grammatophora marina rr.

F. Gjögurtá.

24. V. Hyalodiscus stelliger r.
29. V. Thalassiosira bioculata rr.
19. VI. Peridinium spinosum, aff. rr, Gonyaulax triacantha rr.
15. VIII. Grammatophora marina rr, Nitzschia closterium rr, Rhizosolenia Faeroënsis rr, Glenodinium bipes rr, Gonyaulax triacantha rr, Xanthidium multispinosum rr.
12. X. Grammatophora marina rr.

Samples of the "Thor".

(Table II.)

The No.s of the samples are the same as have been used in the table; when a No. is bracketed, it means that the organism mentioned has been collected at the same place as the sample, but with a different instrument, which is then named.

The hauls with Dr. Petersen's young-fish-trawl and with the egg-net have been made from the "Thor" by Dr. Johs. Schmidt. A description of the young-fish-trawl will soon be published by Dr. Schmidt.

A. East Iceland, May.

1. Xanthidium hystrix rr.
(1.) *Egg-net:* Larvae of Decapoda cc.
(2.) *Young-fish-trawl:* Larvae of Decapoda, Amphipoda, Mysis sp.
5. Rhizosolenia (cylindrus?) rr.
(5.) *Net of silk-taffety:* Biddulphia aurita r, Licmophora Juergensii (?) c, Nitzschia closterium rr, Hyalodiscus stelliger r.
7. Xanthidium hystrix rr.
8. Biddulphia aurita rr, Isthmia enervis rr.
(10.) In a depth of 400—245 m *(Closing-net):* Calanus hyperboreus +, Themisto rr, Euchaeta rr, Conchoecia borealis rr, Aglantha digitalis rr, Spadella hamata +.

B. South Iceland, June.

12. Biddulphia aurita +, Thalassiosira bioculata r, larvae of Echinodermata r, Sagitta rr.
(12.) *Egg-net:* Spadella, Copepoda, especially in the intermediate layers; larvae of Crustacea.
13. Peridinium globulus, aff. rr, Podolampas palmipes rr. Larvae of Echinodermata rr, eggs of Schizopoda +.
14. Hexasterias problematica rr, Oithona similis rr.

(14.) *Net of silk-taffety:* Coccolithophora pelagica +.

Young-fish-trawl, surface: Clione +, Physophora, Thysanopus; in the depth: Thysanopus, Calanus, Themisto, Spadella.

Closing-net, in a depth of 1100—670 m: Litholophus ligurinus r, Acanthometra c, other Radiolaria +, Oncaea conifera c, Sagitta rr; in a depth of 500—350 m: Hexacanthidium sp. r, Acanthometra r, Oncaea conifera +, Pleuromma robusta r, Calanus hyperboreus rr, C. finmarchicus rr, Euchaeta norvegica rr, Oithona similis r, Sagitta r; in a depth of 100—20 m: Hexacanthidium rr, Acanthometra r, Plagiacantha arachnoides +, Ophiopluteus r, Rhincalanus nasutus rr, Calanus finmarchicus r, Oithona similis c, Microsetella atlantica c, eggs of Schizopoda cc.

15. Thalassiothrix Frauenfeldii rr. Eggs of Schizopoda +.

(15.) *Young-fish-trawl,* surface: Clione borealis, Physophora, Bolina, Tomopteris.

(16.) *Young-fish-trawl,* surface: Clione borealis, Physophora, Bolina, Spadella.

Lat. 61° 40′ N., Long. 13° 33′ W. *Young-fish-trawl,* surface: Clione borealis, Aglantha digitalis, Tomopteris, Oikopleura labradoriensis, Thysanopus, Spadella.

Net of silk-taffety, surface: Coccolithophora pelagica.

17. Calanus finmarchicus r.

(17.) *Young-fish-trawl,* surface: Clione borealis, Aglantha, Oikopleura labradoriensis.

18. Microsetella atlantica r, Oithona similis +, Calanus finmarchicus rr.

(18.) *Young-fish-trawl,* surface: Two small Cephalopoda, Cleodora, Clione borealis, Bolina, Aglantha digitalis cc, other small Coelenterata, Tomopteris, Spadella, Thysanopus.

19. Phalacroma minutum rr, Calanus finmarchicus rr.

(19.) *Young-fish-trawl,* surface: Clione borealis, Physophora, Aglantha digitalis, Spadella, Tomopteris, Cephalopod, Oikopleura, Calanus hyperboreus, Euchaeta norvegica.

20. Calanus finmarchicus rr, Oithona similis r, eggs of Schizopoda r.

(20.) *Young-fish-trawl,* surface: Clione borealis, Spadella, Thysanopus.

Lat. 62° 51′ N., Long. 19° 05′ W. *Young-fish-trawl,* surface: Clione borealis, Physophora, Aglantha digitalis, Spadella, Thysanopus.

21. Biddulphia aurita r, Thalassiosira subtilis rr.

22. Larvae of Echinodermata rr.

(22.) Clione borealis.

23. Biddulphia aurita r, Paralia sulcata r.

C. West Iceland, June.

(26.) *Closing-net,* in a depth of 300—180 m: Euchaeta norvegica (with eggs) r, Conchoecia maxima rr, Spadella rr; in a depth of 150—75 m: Euchaeta norvegica +, Spadella rr; in a depth of 70—40 m: Microsetella atlantica rr.

Young-fish-trawl, surface: Clione borealis, Physophora, Aglantha digitalis, Tomopteris, Thysanopus.

(27.) *Young-fish-trawl,* surface: Clione borealis, Aglantha digitalis, Spadella, Themisto.

28. Thalassiothrix Frauenfeldii rr, Coscinodiscus excentricus rr, Podolampas palmipes rr, Peridinium Steinii rr, Euchaeta norvegica r, Themisto r, eggs of Schizopoda r.

(29.) *Young-fish-trawl,* surface: Clione borealis c, Physophora, Aglantha digitalis, two small Cephalopoda, Spirialis, Tomopteris, Thysanopus, Themisto.

30. Xanthidium multispinosum rr.

(30.) *Young-fish-trawl,* surface: Oikopleura r, Amphipoda r; in the depth: Physophora, Sagitta, Thysanopus, larvae of Crustacea.

(31.) *Young-fish-trawl,* surface: Tiara, Sarsia tubulosa, young Aureliae, Sagitta, Philomedes heuda, larvae of Crustacea.

Lat. 66° 15′ N., Long. 23° 30′ W. *Young-fish-trawl,* surface: Clione borealis, Physophora, Aurelia, Spirialis, Philomedes heuda, Microsetella atlantica, other Copepoda.

32. Rhizosolenia Shrubsolii rr.

33. Leprotintinnus pellucidus rr, Microsetella atlantica rr.

D. North Iceland, June—July.

35. Paralia sulcata rr.

36. Oxytoxum Milneri rr, Pterosperma Vanhöffenii rr.

(36.) *Young-fish-trawl,* surface: Clione borealis, Thaumantias, Bolina, Themisto, Thysanopus, larvae of Crustacea.

37. Licmophora sp. c.

(37.) *Young-fish-trawl,* surface: Clione borealis rr, Physophora c, Bolina r, Limacina; in the depth: Physophora, Bolina c, Thaumantias, Themisto.

38. Dinobryon pellucidum r.

(39.) *Young-fish-trawl,* surface: Clione +, Thysanopus.

40. Biddulphia aurita rr, Epithemia sp. +.

(40.) *Young-fish-trawl,* surface: Clione borealis rr, Themisto rr, Thysanopus.
Egg-net, surface: Larvae of crabs cc, Copepoda.

41. Pterosperma Vanhöffenii rr, Cyttarocylis annulata rr, Leprotintinnus pellucidus rr.

(41.) *Young-fish-trawl,* surface: Bolina r; in the depth: Bolina r, Themisto, Thysanopus.

42. Pterosperma Vanhöffenii rr, larvae of Echinodermata rr.

(42). *Young-fish-trawl,* surface: Themisto cc, Beroë r, Aglantha digitalis r; in the depth: Beroë, Themisto, Thysanopus.

43. Larvae of Echinodermata rr.

44. Microsetella atlantica rr, larvae of Echinodermata rr.

45. Pterosperma Vanhöffenii r.

(45.) *Young-fish-trawl,* surface: Clione borealis rr, Beroë r, Thaumantias r, Limacina helicina cc, Themisto cc; in the depth: Clione borealis rr, Aglantha digitalis, Beroë, Spadella, Themisto r, Limacina helicina r, Oikopleura.

E. West Iceland, July.

46. Nitzschia sp. (in Phaeocystis Pouchetii) c, Paralia sulcata r.

(46.) *Young-fish-trawl,* surfarce: Beroë, Bolina, Sarsia and other Craspedota, Thaumantias cc, Themisto r.

47. Nitzschia sp. (in Phaeocystis Pouchetii) c.

(47.) *Young-fish-trawl,* surface: Beroë, Themisto, larvae of crabs.

48. Biddulphia aurita rr, Nitzschia sp. (in Phaeocystis Pouchetii) c.

49. Rhizosolenia setigera rr, Hexasterias problematica rr, Xanthidium multispinosum rr, Larvae (Megalops) c.

F. South Iceland, July.

50. Rhizosolenia Shrubsolii rr, Peridinium spinosum, aff. rr.

51. Microsetella atlantica rr.

(51). *Young-fish-trawl,* surface: Beroë c, Craspedota c; in the depth; Bolina c, Craspedota c, Clione borealis rr.

52. Xanthidium multispinosum rr, Microsetella atlantica rr.
53. Thalassiothrix Frauenfeldii rr, Xanthidium multispinosum rr.
(54.) *Young-fish-trawl,* surface: Clione borealis rr, Physophora, Beroë c, Themisto; in the depth: Beroë +, Aglantha digitalis, Physophora, Sagitta, Themisto, Thysanopus c.
55. Dinophysis homunculus rr, Peridinium oceanicum rr, P. Steinii rr.
(55.) *Young-fish-trawl,* surface: Clione borealis rr, Beroë, Themisto; in the depth: Themisto cc, Beroë r.
56. Rhynchomonas marina rr, Microsetella atlantica rr.
57. Rhizosolenia Shrubsolii rr, Peridinium Steinii rr, Pterosperma labyrinthus rr, Protocystis (Challengeria) bicornis rr, Microsetella atlantica rr, Conchoecia sp. rr, Tiarina fusus rr.
(57.) *Young-fish-trawl,* surface: Clione borealis c, Spirialis +, Cleodora pyramidalis +, Aglantha digitalis ccc, Physophora c, Craspedota r, Tomopteris c; in the depth: Clione borealis r, Aglantha digitalis, Spadella, Thysanopus, Themisto.
58. Thalassiothrix Frauenfeldii rr, Pterosperma labyrinthus rr, Undella caudata rr, Spadella rr.
59. Larvae of Gastropoda rr.
60. Larvae of Gastropoda rr.

Lat. 62° 35′ N., Long. 19° 48′ W. *Young-fish-trawl,* surface: Clione borealis r, Cleodora pyramidalis r, Spirialis r, Aglantha digitalis c, Thaumantias, Eucope, Tomopteris.

61. Peridinium globulus, aff. rr, P. Steinii rr, Pterosperma Möbii rr, Microsetella atlantica r.
62. Peridinium decipiens rr, P. pentagonum rr.
(62.) *Young-fish-trawl,* surface: Beroë and Craspedota.

Portland Head. *Young-fish-trawl,*: Clione borealis r, Aurelia, Beroë, Eucope, Thaumantias, Aglantha digitalis, Physophora, Spadella, larvae of crabs c, Thysanopus.

63. Rhizosolenia Shrubsolii rr, Microsetella atlantica +.
(63.) *Egg-net,* surface: Themisto cc.
64. Xanthidium multispinosum rr, Microsetella atlantica rr, Evadne Nordmanni rr.

G. East Iceland, July—August.

65. Lauderia glacialis rr.
(65.) *Young-fish-trawl,* surface: only Diatoms; at the bottom: Spadella c, Thysanopus.

Lat. 64° 34′ N., Long. 13° 56′ W. *Young-fish-trawl,* surface: Clione borealis rr, Thysanopus; in the depth: Sagitta, larvae of Crustacea.

66. Rhabdonema arcuatum rr.
67. Licmophora sp. rr, Nitzschia closterium r, Rhabdonema arcuatum r.
68. Hyalodiscus stelliger rr, Licmophora sp. rr.
69. Peridinium Steinii rr.
70. Peridinium Steinii rr.

Lat. 65° 42′ N., Long. 13° 45′ W. *Young-fish-trawl,* surface: Clione borealis +.

71. Peridinium Steinii r.
72. Peridinium Steinii +.

Table I. 1.

S/S "Hola

Nr. / Locality	Vestmanna-eyjar.		A. Hrolaugseyjar.													
Date	15. IV.	16. V.	17. IV.	7. V.	18. V.	5. VI.	12. VI.	2. VII.	11. VII.	1. VIII.	9. VIII.	29. VIII.	6. IX.	26. IX.	6. X.	1.
Surface temperature	5.4	7.4	6.5	7.2	6.8	7.7	8.6	9.4	9.8	8.0	8.2	8.0	9.0	9.2	8.0	
Surface salinity	35.32	33.55	35.23	35.30	35.21	35.14	34.87	34.87	32.75	34.74	33.39	34.43	34.96	34.83	34.75	3
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Asterionella japonica Cleve	...	ccc	...	...	+	cc	cc	...	...	...	...	...	...	...	...	
Bacteriastrum varians Laud.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bacterosira fragilis Gran.	...	..	...	...	...	...	...	...	...	...	...	...	...	...	..	
Biddulphia aurita (Lyngb.) Bréb.	...	rr	...	+	...	...	rr	...	...	...	...	...	...	rr	...	
Chaetoceras atlanticum Cleve	+	..	...	+	...	...	...	...	...	...	...	...	...	...	...	
— cinctum Gran.	...	r	...	...	+	r	r	...	...	...	+	r	rr	...	...	
— constrictum Gran.	...	...	...	...	...	r	...	...	...	...	...	...	...	...	...	
— contortum Schütt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— debile Cleve	...	+	...	...	+	c	+	...	...	r	...	rr	+	...	rr	
— decipiens Cleve	c	r	+	c	r	cc	+	+	+	+	r	rr	+	+	+	
— diadema (Ehbg.) Gran.	...	r	...	...	r	+[1]	...	...	...	...	...	...	...	...	...	
— furcellatum Bail.	...	...	...	...	...	r	...	...	...	r	...	...	...	...	r	
- gracile Schütt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— Ingolfianum Ostf.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— laciniosum Schütt.	...	...	...	...	...	r	...	...	+	...	...	...	...	...	...	
— peruvianum Btw.	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	rr	
— simile Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— teres Cleve	...	...	...	r	r	...	rr	...	...	...	...	...	...	...	...	
— Wighami Btw.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Corethron criophilum Castr.	...	...	...	...	...	...	...	...	...	...	...	...	r	rr	+	
Coscinodiscus oculus iridis Ehbg.	+	...	r	+	+	+	+	r	rr	...	...	...	...	...	rr	
- radiatus Ehbg.	+	r	r	c	+	...	...	...	...	...	...	...	...	...	...	
Coscinosira polychorda Gran.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Dactyliosolen antarcticus Castr.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Fragilaria islandica Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	
Isthmia nervosa Kütz	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Lauderia borealis Gran.	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	
Leptocylindrus danicus Cleve	...	rr	...	...	...	...	...	...	...	...	rr	...	...	...	...	
Nitzschia seriata Cleve	...	r	...	...	...	+	rr	...	...	...	...	...	...	...	...	
Paralia sulcata (Ehbg.) Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	
Rhabdonema arcuatum (Lyngb.) Kütz.	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	
Rhizosolenia alata Btw.	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	
— Debyana Perag.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— hebetata Bail.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— semispina Hensen	...	...	...	...	...	...	...	r	rr	...	...	...	...	...	...	
- styliformis Btw.	rr	...	...	...	...	...	...	...	...	...	...	...	r	...	...	
Skeletonema costatum (Grev.) Cleve	...	r	...	...	+	...	c	...	...	...	...	...	...	...	...	
Thalassiosira gravida Cleve	...	+	...	+	cc	c	c	+	...	...	...	...	...	...	...	
— hyalina (Grun.) Gran.	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	
— Nordenskiöldii Cleve	...	r	...	...	cc	+	...	+	...	...	...	...	...	...	...	
Thalassiothrix Frauenfeldii Grun.	...	...	...	...	rr	...	...	rr	...	...	...	...	+	...	...	
Pterosperma Vanhöffenii (Jörgs.) Ostf.	...	...	...	rr	...	...	...	...	...	...	rr	r	rr	rr	+	
Ceratium arcticum Ehbg.	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	
— furca (Ehbg.) Clap. et Lachm.	...	...	rr	...	...	...	...	+	r	r	r	+	r	rr	r	
— fusus (Ehbg.) Duj.	...	...	...	...	...	...	...	r	rr	r	c	+	+	r	+	
- horridum Cleve	+	...	r	rr	...	...	...	rr	...	r	r	...	r	+	rr	
— lineatum (Ehbg.) Cleve	...	...	...	...	...	...	...	...	...	+	c	r	r	...	...	
— longipes (Bail.) Cleve	r	...	...	...	...	...	...	r	...	+	+	c	+	r	c	
- tripos (O. F. M.) Nitzsch.	rr	...	...	...	...	...	...	...	...	r	+	r	r	r	r	
Dinophysis acuminata Clap. et Lachm.	...	rr	...	...	...	...	...	c	rr	r	r	...	...	...	...	
— acuta Ehbg.	..	...	rr	rr	...	...	...	r	rr	r	+	r	r	...	...	
— rotundata Clap et Lachm.	...	...	...	...	...	...	...	...	r	+	+	+	r	...	rr	
Diplopsalis lenticula Bergh.	...	...	...	...	...	...	...	r	...	...	r	+	+	r	r	
Goniodoma Ostenfeldii O. Pauls.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Gonyaulax spinifera (Clap. et Lachm.) Dies.	...	rr	...	...	...	...	...	r	...	+	r	...	...	...	...	
Heterocapsa triquetra (Ehbg.) Stein.	...	...	...	...	...	...	...	rr	...	+	rr	...	...	...	...	
Peridinium conicum Gran.	...	...	...	...	...	rr	rr	+	r	rr	r	...	...	...	...	
— depressum Bail.	...	...	...	...	...	...	...	+	+	r	+	r	r	...	r	
— divergens Ehbg.	...	...	...	rr	...	...	...	rr	...	...	r	r	rr	rr	r	
— islandicum O. Pauls.	...	...	...	...	...	...	...	...	...	r	+	...	...	...	...	
— ovatum (Pouch.) Schütt	rr	...	...	rr	...	...	...	+	cc	cc	c	c	...	rr	rr	
– pallidum Ostf.	...	...	...	...	...	...	...	rr	+	+	r	+	r	rr	r	
— pellucidum (Bergh.) Schütt	...	rr	...	...	rr	rr	...	r	+	r	r	...	rr	...	rr	
– Steinii Jörgs.	...	...	...	...	...	...	...	...	...	...	r	rr	...	...	...	
Podolampas palmipes Stein.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Dictyocha fibula Ehbg.	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	
— speculum Ehbg.	...	...	...	...	r	rr	...	...	...	...	...	...	...	...	...	
Radiolaria	r	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	
Globigerina bulloides d'Orb.	r	...	...	rr	...	...	...	...	...	...	...	...	rr	...	...	
Amphorella subulata (Ehbg.) Dad.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

[1] cum sporis.

	B. Papey.									C. Digranes.							
V. .8 .67	4. VI. 7.6 31.87	13. VI 3.2 34.29	2. VII. 7.4 33.93	12. VII. 3.6 34.18	1. VIII. 4.2 34.23	28. VIII. 6.0 33.98	7. IX. 8.0 33.96	26. IX. 5.8 33.86	31. X. 4.8 34.22	22. IV. ÷ 1.1 34.69	31. V. 4.2 35.07	26. VII. 6.0 33.28	14. VIII. 6.6 33 66	25. VIII. 5.8 33.46	20. IX. 4.8 34.16	11. X. 4.6 34.11	26. X. 4.0 34.34
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Table I. 2.

Nr / Locality	D. Langanes.												
Date	23. IV.	1. V.	23. V.	30. V.	18. VI.	27. VI.	16. VII.	26. VII.	14. VIII.	24. VIII.	11. IX.	20. IX.	11. X.
Surface temperature	1.0	0.5	1.2	3.4	6.4	6.3	5.0	6.2	6.6	5.4	5.2	5.6	5.6
Surface salinity	34.61	34.70	34.33	34.07	32.48	34.13	35.39	34.05	33.66	33 95	33.91	33.84	34.13
Asterionella japonica Cleve		*				*	*						
Bacteriastrum varians Laud.													
Bacterosira fragilis Gran.					r	rr							
Biddulphia aurita (Lyngb.) Bréb.													
Chaetoceras atlanticum Cleve													
— cinctum Gran.													
— constrictum Gran.													
— contortum Schütt													
— debile Cleve					r							r	
— decipiens Cleve		rr			r	rr	+	⊥	cc	c			
— diadema (Ehbg.) Gran.					c		c		+	rr	+	⊥	
— furcellatum Bail					r						r		r
— gracile Schütt													
— Ingolfianum Ostf.													
— laciniosum Schütt					rr						+		r
— peruvianum Btw.		r	rr	c	ccc	cc	r	rr	+	—	+	⊥	c
— simile Cleve													
— teres Cleve					rr								
— Wighami Btw.													
Corethron criophilum Castr.											rr		r
Coscinodiscus oculus iridis Ehbg.													
— radiatus Ehbg.													
Coscinosira polychorda Gran.													
Dactyliosolen antarcticus Castr.													
Fragilaria islandica Cleve		r	+	r		r					rr		
Isthmia nervosa Kütz	rr												
Lauderia borealis Gran.													
Leptocylindrus danicus Cleve													
Nitzschia seriata Cleve											rr	rr	
Paralia sulcata (Ehbg.) Cleve													
Rhabdonema arcuatum (Lyngb.) Kütz.	r	r	r				rr	r			⊥	rr	
Rhizosolenia alata Btw.													
Debyana Perag.													
— hebetata Bail.													
semispina Hensen					+	+	r	+	+	⊥		r	
- styliformis Btw.										cc	r	ccc	
Skeletonema costatum (Grev.) Cleve													
Thalassiosira gravida Cleve	c	+	r	+	+	r	+						
— hyalina (Grun.) Cleve	c												
— Nordenskiöldii Cleve	c				+								
Thalassiothrix Frauenfeldii Grun.													
Pterosperma Vanhöffenii (Jörgs.) Ostf.								rr					
Ceratium arcticum Ehbg.							rr	rr	rr	+		rr	
— furca (Ehbg.) Clap. et Lachm.													
— fusus (Ehbg.) Duj.								rr					
— horridum Cleve							rr						
lineatum (Ehbg.) Cleve													
— longipes (Bail.) Cleve								+	rr	+	rr	r	
tripos (O. F. M.) Nitzsch.													
Dinophysis acuminata Clap. et Lachm.								rr					
— acuta Ehbg.													
— rotundata Clap. et Lachm.			rr				+	r	rr				
Diplopsalis lenticula Bergh.								r			rr		
Goniodoma Ostenfeldii O. Pauls.							rr						
Gonyaulax spinifera (Clap. et Lachm.) Dies.													
Heterocapsa triquetra (Ehbg.) Stein.									rr				
Peridinium conicum Gran.													
— depressum Bail.										r			
— divergens Ehbg.													
— islandicum O Pauls.								r					
— ovatum (Pouch.) Schütt					rr			r					
— pallidum Ostf.													
— pellucidum (Bergh.) Schütt		rr			r						r		
— Steinii Jörgs.								r					
Podolampas palmipes Stein.													
Dictyocha fibula Ehbg.													
— speculum Ehbg.		rr			rr								
Radiolaria	rr												
Globigerina bulloides d'Orb.													
Amphorella subulata (Ehbg.) Dad.													

[1]) cum sporis.

003.

E. Rödehuk.

IV.	24. V.	30. V.	18. VI.	26 VI.	16. VII.	25. VII.	15. VIII.	22. VIII.	12 IX.	11. X.	24. X.
0.2	4.6	3.6	4.2	6.0	9.0	5.6	6.0	5.5	4.2	4.5	4.2
47	33.53	32 14	33.64	33 28	29.81	33.91	33.86	33.24	33 78	34.29	34.63

F. Gjögurtá.

24. IV.	24. V.	29. V.	19. VI.	25. VI.	24. VII.	15. VIII.	13. IX.	12. X.	23. X.
0.1	2.3	3.4	4.9	6.2	4.6	6.2	4 8	4.5	1.4
34.54	33.24	33.22	33.37	33.55	33.96	33.21	31.85	34.31	34.56

Table I. 1. *Continued.*

Nr. / Locality	Vestmanna-eyjar.	A. Hrolaugseyjar.												
Date	15. IV.	16. V.	17. IV.	7. V.	18. V.	5. VI.	12. VI.	2. VII.	11. VII.	1. VIII.	9. VIII.	29. VIII.	6. IX.	26. IX.	6. X.
Surface temperature	5.4	7.4	6.5	7.2	6.8	7.7	8.6	9.4	9.8	8.0	8 2	8.0	9.0	9.2	8.0
Surface salinity	35.32	33.55	35.23	35.30	35.21	35.14	34.87	34.87	32.75	34.74	33.39	34.43	34.96	34.83	34.75
	*	*	*	*	*					*	*	*	*		*
Codonella ventricosa (Clap. et Lachm.) Fol.	...	...	...	...	rr	...	...	...	...	r	r	rr	+	+	c
Cyttarocylis denticulata (Ehbg.) Fol.	...	+	...	+	r	...	...	c	c	+	c	cc	cc	+	+
— gigantea Brandt	...	...	...	...	...	...	...	...	rr	rr	+	r	r	r	...
— norvegica (Dad.) Jörgs.	...	+	...	...	rr	rr	...	...	+	+	+	+	r	r	...
Ptychocylis urnula (Clap. et Lachm.) Brandt	...	...	...	...	...	...	...	...	r	r	+	+	+	c	+
Tintinnus acuminatus Clap. et Lachm.	...	...	...	...	rr	...	...	rr	...	...	...	rr	...	rr	r
Tintinnopsis Karajacensis Brandt, v. acuta O. P.	...	...	...	...	...	...	...	...	+	+	+	...	...	...	...
Ophiopluteus sp.	rr	...	...	r	...	...	...	...	...	...	...	...	...	...	rr
Microsetella atlantica Br. et Rob.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other Copepoda	r	...	...	+	...	+	...	...	...	...	...	+	...	+	r
Nauplius	+	...	rr	r	...	+	r	r	r	...	c	c	+	c	c
Larvae of Gastropoda	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— - mushels	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	r
Fish-eggs	c	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1. 2. *Continued.*

Nr. / Locality	D. Langanes.												
Date	23. IV.	1. V.	23. V.	30. V.	18. VI.	27. VI.	16. VII.	26. VII.	14. VIII.	24. VIII.	11. IX.	20. IX.	11. X.
Surface temperature	1.0	0.5	1.2	3.4	6.4	6.3	5.0	6.2	6.6	5.4	5.2	5.6	5.6
Surface salinity	34.61	34.70	34.33	34.07	32.48	34.13	33.39	34.05	33.66	33.95	33.91	33.84	34.13
		*				*	*						
Codonella ventricosa (Clap. et Lachm.) Fol.	...	...	rr	...	...	...	...	...	rr	...	...	...	...
Cyttarocylis denticulata (Ehbg.) Fol.	...	...	...	...	...	r	+	r	...	...	...	...	rr
- gigantea Brandt	...	...	...	...	...	...	r	r	+	c	...	...	...
— norvegica (Dad.) Jörgs.	...	...	...	...	...	...	...	...	...	...	r	rr	...
Ptychocylis urnula (Clap. et Lachm.) Brandt	...	...	...	...	...	r	+	rr	...	...	...	...	r
Tintinnus acuminatus Clap. et Lachm.	...	...	...	...	...	...	...	...	...	...	...	...	...
Tintinnopsis Karajacensis Brandt, v. acuta O. P.	...	...	...	...	...	...	...	...	...	...	...	...	...
Ophiopluteus sp.	...	...	...	...	...	...	...	...	...	...	...	...	...
Microsetella atlantica Br. et Rob.	...	rr	...	rr	...	...	...	...	...	...	...	...	...
Other Copepoda	...	rr	r	rr	...	...	...	...	...	c	...	...	c
Nauplius	...	rr	...	...	...	rr	+	+	r	c	r	+	cc
Larvae of Gastropoda	...	...	...	...	...	...	...	...	...	...	...	...	...
- mushels	...	...	...	...	...	...	...	rr	...	...	...	...	...
Fish-eggs	...	...	...	...	...	...	...	...	...	...	...	...	...

B. Papey.

C. Digranes.

V.	4. VI.	13. VI.	2. VII.	12. VII.	1. VIII.	28. VIII.	7. IX.	26. IX.	31. X.	22. IV.	31. V.	26. VII.	14. VIII.	25. VIII.	20. IX.	11. X.	26. X.
.0	7.6	3.2	7.4	3.6	4.2	6.0	8.0	5.8	4.8	÷ 1.1	4.2	6.0	6.6	5.8	4.8	4.6	4.9
.67	31.87	34.29	33.93	34.18	34.23	33.98	33.96	33.86	34.22	34.69	35.07	33.28	33.66	33.46	34.16	34.11	34.34

E. Rödehuk.

F. Gjögurtá.

IV.	24. V.	30. V.	18. VI.	26. VI.	16. VII.	25. VII.	15. VIII.	22. VIII.	12. IX.	11. X.	24. X.	24. IV.	24. V.	29. V.	19. VI.	25. VI.	24. VII.	15. VIII.	13. IX.	12. X.	23. X.
0.2	4.6	3.6	4.2	6.0	9.0	5.6	6.0	5.5	4.2	4.5	4.2	0.1	2.3	3.4	4.9	6.2	4.6	6.2	4.8	4.5	4.4
.47	33.53	32.14	33.64	33.28	29.81	33.91	33.86	33.24	33.78	34.29	34.63	34.54	33.24	33.22	33.37	33.55	33.96	33.21	31.85	34.31	34.56

Table II. 1.

S/s "Tho

	A. East Iceland, May 1903.											B. South Ice			
Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Locality	Mjoi-fjord	Eske-fjord	Röde-fjord	Seley	Seydis-fjord	Dalatangi		64°58 13°25	64°58 11°45	66°09 10°45		Eystra-horn	Stakka-nes	63°13 14°16	63 15
Date	26. V.	29. V.	29. V.	29. V.	20. V.	24. V.		16. V.	16. V.	25. V.		30. V.	1. VI.	31. V.	1.
Time	7 p.	4 p.	6 p.	8 p.	5 p.	8 a.		12 d.	2 a.	5 a.		6 p.	2 p.	11 a.	9
Vertical Haul, Depths (in M.)	.....	.....	20—0	.....	.....	70—30	20—0	.....	.....	.....	100-45	.....	.....	.....	...
Horizontal Haul (Surface), Duration (Minutes)	5	5	.....	5	5	.....	.....	5	5	5	.....	5	5	5	
	*	*			*			*		*		*	*	*	
Asterionella japonica Cleve	...	...	...	...	...	...	...	..	...	...	...	+	ccc	cc	c
Bacteriastrum delicatulum Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bacterosira fragilis Gran.	+	..	c	r	+	r	c	...	...	...	...	r	...	...	
Cerataulina Bergoni Perag.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Chaetoceras atlanticum Cleve	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	
— boreale Btw.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
cinctum Gran.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
constrictum Gran.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
contortum Schütt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
debile Cleve	...	...	...	...	...	...	...	...	...	...	...	...	c	cc	
decipiens Cleve	...	r	...	...	...	...	...	...	rr	...	...	r	c	+	
diadema (Ehbg.) Gran.	...	c	...	+[1]	rr	...	...	r	...	...	...	...	c	+	
— furcellatum Bail.	c	+	cc[1]	c	c[1]	r	r	...	...	...	...	+[1]	+	c	
laciniosum Schütt	...	+	...	+	r	...	...	...	...	...	...	...	r	+	
— pelagicum Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— peruvianum Btw.	...	rr	+	c	rr	c	+	+	ccc	ccc	ccc	...	...	...	
— Schüttii Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
teres Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Coscinodiscus oculus iridis Ehbg.	...	...	...	...	...	...	...	...	...	...	...	+	r	...	
— radiatus Ehbg.	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	
Coscinosira polychorda Gran.	...	...	c	...	r	...	r	...	...	...	...	...	...	...	
Fragilaria oceanica Cleve	c	+	...	...	rr	...	...	rr	...	...	...	...	...	...	
Leptocylindrus danicus Cleve	r	...	r	...	rr	...	r	...	...	...	...	...	...	...	
Nitzschia seriata Cleve	...	rr	...	...	...	...	...	...	...	...	...	...	cc	+	
Rhizosolenia alata Btw.	...	...	...	...	...	...	...	...	...	...	...	...	...	+	
— gracillima Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— semispina Hensen	...	...	...	r	...	...	...	...	c	c	c	rr	...	...	
— styliformis Btw.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Skeletonema costatum (Grev.) Cleve	...	...	...	...	r	...	...	...	...	...	...	...	...	r	
Thalassiosira bioculata (Grun.) Ostf.	...	...	r	+	...	...	...	...	...	...	...	r	...	...	
— gravida Cleve	cc	+	ccc	cc	cc	c	cc	c	...	...	+	cc	cc	+	
— hyalina (Grun.) Gran.	c	r	c	c	cc	+	cc	+	...	...	...	...	...	...	
— Nordenskiöldii Cleve	cc	c	ccc	cc	c	c	cc	+	...	...	+	c	c	r	
Thalassiothrix longissima Cleve et Grun.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Ceratium arcticum Ehbg.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— furca (Ehbg.) Clap. et Lachm.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— fusus (Ehbg.) Duj.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— horridum Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— lineatum (Ehbg.) Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— longipes (Bail.) Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— tripos (O. F. M.) Nitzsch.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Dinophysis acuminata Clap. et Lachm.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— acuta Ehbg.	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	
— rotundata Clap. et Lachm.	...	...	...	...	...	...	...	...	...	...	...	r	...	...	
Diplopsalis lenticula Bergh.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Goniodoma Ostenfeldii O. Pauls	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Gonyaulax spinifera (Clap. et Lachm.) Dies.	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	
triacantha Jörgs.	...	r	...	...	...	...	...	...	...	...	...	...	...	...	
Peridinium conicum Gran.	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	
— depressum Bail.	...	...	...	...	...	...	...	...	...	...	...	...	r	...	
— divergens Ehbg.	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	
islandicum O. Pauls.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— ovatum (Pouch.) Schütt	...	rr	...	r	...	...	...	...	...	...	...	+	+	...	
— pallidum Ostf.	...	...	...	r	rr	...	...	...	...	...	...	...	r	...	
— pellucidum (Bergh.) Schütt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— roseum O. Pauls	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Phaeocystis Pouchetii (Har.) Lagerh.	...	...	...	...	c	...	...	+	...	...	...	...	...	...	
Coccolithophora pelagica (Wall.) Lohm.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Dictyocha speculum Ehbg.	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	
Radiolaria	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Amphorella subulata (Ehbg.) Dad.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Codonella ventricosa (Clap. et Lachm.) Fol.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Cyttarocylis denticulata (Ehbg.) Fol.	...	...	...	...	...	...	...	...	...	...	...	r	...	rr	
— gigantea Brandt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
— norvegica (Dad.) Jörgs.	...	+	...	...	...	...	...	...	...	...	...	...	...	...	
Ptychocylis urnula (Clap. et Lachm.) Brandt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Tintinnopsis karajacensis Brandt v. acuta O. Pauls.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Globigerina bulloides d'Orb.	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	
Copepoda	...	rr	...	...	...	...	...	...	+	...	...	r	...	...	
Nauplii	...	...	...	...	...	...	...	...	...	...	...	r	...	...	
Larvae of mushels	...	...	...	...	...	...	...	...	...	...	...	+	...	...	

[1]) cum sporis.

03.

1903.

C. West Iceland, June 1903.

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
°17	61°31	61°31	62°01	62°21	Vestmannaeyjar	Skagi	Reykjavik	64°10	64°10	64°13	65°29		65°45	66°10	Mouth of Önundarfjord	66°33	Mouth of Isafjord	
°12	17°08	19°05	19°05	19°05				23°57	27°00	27°30	28°32		27°03	24°42		22°47		
VI.	3. VI.	3. VI.	3. VI.	3. VI.	5. VI.	10. VI.	9. VI.	10. VI.	11. VI.	11. VI.	12. VI.		13. VI.	13. VI.	15. VI.	16. VI.	.....	.....
a.	11 a.	4 p.	8 p.	11 p.	12 d.	3 p. 15 –0	11 a.	7 p.	12 d.	4 p.	4 p.		1 a.	2 p.	7 p.	2 a.	.....	.....
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rr	r	rr	+	r				r	+	c	+	+	rr					
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cc	+	+	c	+	c	rr		c	+	cc	c	cc	cc	r	rr	c		r
c	+	c	c	c				+		r	r	r	r			rr		
						r			cc	cc	+	cc	r					
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–	r	r	r	+	c	c		ccc	+	+	cc	+[1])	cc[1])	cc[1])	+	cc	r	cc
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Table II. 2.

S.s "Tho

Nr.	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
	D. North Iceland, June—July 1903.											E. West Iceland, July 19			
Locality	Cap Nord	66°13 20°29	66°15 18°58	Aku-reyri	Hrisey	Husa-vik	Grimsey	Brik-Skær			66°17 21°14	Cap Nord	Isafjord		Br b
Date	17. VI.	17. VI.	17. VI.	19. VI.	19. VI.	19. VI.	30. VI.	1. VII.			2. VII.	2. VII.	2 VII.		3.
Time	1 p.	9 p.	12 n.	3 p.	7 p.	11 p.	10 a.	9 p.				7 p.	9 p.		1
Vertical Haul, Depths (in M.)	.....	.....	.....	.....	.....	.....	.....	150-70	50—30	15—0	.....	.....	15—10	.....	
Horizontal Haul (Surface), Duration (Minutes)	5	5	5	5	5	5	5	.....	.....	.....	5	5	.....	5	
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Asterionella japonica Cleve	...	...	...	...	...	...	...	...	...	...	...	+	cc	+	
Bacteriastrum delicatulum Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bacterosira fragilis Gran.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Cerataulina Bergoni Perag.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Chaetoceras atlanticum Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
boreale Btw.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
cinctum Gran.	+	c	...	...	...	...	...	...	...	...	...	...	...	...	
constrictum Gran.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
contortum Schütt	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	
debile Cleve	r	...	..	r	+	c	..	...	...	..	...	+	+	c	
decipiens Cleve	...	r	r	c	+	+	r	...	rr	r	...	+	+	r	
diadema (Ehbg.) Gran.	...	...	...	+	c	+	...	...	...	...	...	+[1]	+	c[1]	
furcellatum Bail.	...	...	cc	c	+	+	...	...	rr	rr	...	c	rr	...	
laciniosum Schütt	...	...	..	r	...	...	...	...	...	...	...	...	+	+	
pelagicum Cleve	...	...	..	...	...	...	...	...	...	...	...	...	...	...	
peruvianum Btw.	...	+	+	r	cc	+	+	c	cc	+	...	...	...	+	
Schüttii Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
teres Cleve	...	...	...	...	...	...	...	...	...	...	...	...	r	...	
Coscinodiscus oculus iridis Ehbg.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
radiatus Ehbg.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Coscinosira polychorda Gran.	...	...	...	rr	r	...	...	...	...	...	...	...	...	...	
Fragilaria oceanica Cleve	r	...	...	...	...	...	...	...	...	...	...	...	...	...	
Leptocylindrus danicus Cleve	...	...	...	...	...	...	r	...	...	rr	...	...	...	r	
Nitzschia seriata Cleve	rr	...	...	...	...	...	...	...	...	...	...	+	r	+	
Rhizosolenia alata Btw.	rr	...	rr	...	...	r	...	...	...	...	...	...	...	rr	
gracillima Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
semispina Hensen	...	rr	r	+	+	+	+	...	+	+	...	r	rr	rr	
styliformis Btw.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Skeletonema costatum (Grev.) Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Thalassiosira bioculata (Grun.) Ostf.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
gravida Cleve	r	+	+	...	rr	...	...	...	...	...	...	c	r	r	
hyalina (Grun.) Gran.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Nordenskiöldii Cleve	...	...	+	...	...	...	...	...	...	...	...	...	+	...	
Thalassiothrix longissima Cleve et Grun.	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	
Ceratium arcticum Ehbg.	..	rr	...	...	...	rr	...	...	...	...	+	...	...	...	
furca (Ehbg.) Clap. et Lachm.	...	...	..	...	...	...	...	...	...	...	...	...	...	...	
fusus (Ehbg.) Duj.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
horridum Cleve	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
lineatum (Ehbg.) Cleve	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	
longipes (Bail.) Cleve	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	
tripos (O. F. M.) Nitzsch.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Dinophysis acuminata Clap. et Lachm.	r	+	r	...	...	...	rr	...	...	...	...	...	...	...	
acuta Ehbg.	...	...	...	...	...	...	rr	...	...	...	...	...	...	rr	
rotundata Clap. et Lachm.	rr	...	...	...	...	rr	+	...	...	r	+	...	...	r	
Diplopsalis lenticula Bergh.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Goniodoma Ostenfeldii O. Pauls	+	rr	r	r	+	r	c	r	r	c	...	r	...	...	
Gonyaulax spinifera (Clap. et Lachm.) Dies.	r	r	r	...	r	r	r	...	...	...	...	r	...	r	
triacantha Jörgs.	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	
Peridinium conicum Gran.	rr	rr	r	...	rr	...	...	...	...	r	...	r	...	rr	
depressum Bail.	...	...	...	rr	...	...	r	r	+	...	+	r	...	...	
divergens Ehbg.	rr	...	+	...	...	...	...	...	...	...	...	...	...	...	
islandicum O. Pauls.	...	...	...	...	...	...	...	...	...	...	+	...	...	...	
ovatum (Pouch.) Schütt.	r	c	...	...	r	...	r	+	r	+	c	...	r	+	
pallidum Ostf.	rr	r	r	...	...	...	rr	...	...	...	r	...	...	rr	
pellucidum (Bergh.) Schütt	c	cc	c	+	+	+	+	r	r	+	c	r	r	...	
roseum O. Pauls	...	...	...	...	r	...	+	...	...	...	...	...	...	...	
sp.	...	...	...	...	...	...	...	...	...	...	...	r	...	...	
Phaeocystis Pouchetii (Har.) Lagerh.	...	+	+	...	r	...	...	...	...	...	...	c	cc	+	
Coccolithophora pelagica (Wall.) Lohm.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Dictyocha speculum Ehbg.	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	
Radiolaria	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Amphorella subulata (Ehbg.) Dad.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Codonella ventricosa (Clap. et Lachm.) Fol.	...	rr	...	...	...	...	...	r	...	...	...	...	...	r	
Cyttarocylis denticulata (Ehbg.) Fol.	+	...	+	...	...	+	c	...	...	r	rr	c	+	c	
gigantea Brandt	rr	+	+	...	...	...	+	r	...	...	rr	...	...	...	
norvegica (Dad.) Jörgs.	rr	...	+	+	...	...	r	rr	...	...	...	...	...	rr	
Ptychocylis urnula (Clap. et Lachm.) Brandt	rr	...	...	...	...	r	...	+	+	r	...	rr	+	r	
Tintinnopsis karajacensis Brandt v. acuta O. Pauls.		r	+	cc	+	...	r	...	rr	+	...	+	...	r	
Globigerina bulloides d'Orb.	..	...	...	...	...	...	...	r	...	rr	...	...	...	...	
Copepoda	r	+	...	...	...	...	r	c	...	...	...	r	r	r	
Nauplii	r	+	+	...	...	r	rr	...	+	...	+	+	...	...	
Larvae of mushels	rr	...	...	...	...	...	+	+	r	+	...	...	...	...	

[1]) cum sporis.

F. South Iceland, July 1903.

G. East Iceland, July—August 1903.

	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
	Faxe-bugt	Rey-kjavik	Rey-kjanes	63°40 21°58	Vest-manna-eyjar	62°54 20°13	62°10 19°36				63°05 20°07	63°30 20°00	63°19 15°50	63°49 15°06	64°18 14°32	Beru-fjord	Röde-fjord	Seydis-fjord	Glettin-ganes	65°42 13°45	64°58 12°40	64°58 11°15
	4. VII.	10. VII.	11. VII.	11. VII.	12. VII.	12. VII.	13. VII.				14. VII.	18. VII.	19. VII.	20. VII.	20. VII.	1. VIII.	31. VII.	25. VII.	26. VII.	26. VII.	4. VIII.	4. VIII.
	7 p.	10 a.	1 p.	4 p.	10 a.	4 p.	8 a.				3 p.	1 p.	12 n.	6 a.	11 a.	3 p.	1 p.	11 a.	9 a	7 p	5 p	7 p
	5	5	5	5	5	5	1800-1000	500-300	90-70	5	5	5	5	5	5	5	5	5	5	5	5	5

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Important Corrections.

Page 3, 7 lines from foot, after V, West Iceland, July read: VI, South Iceland, July; VII, East Iceland, July—August.
— 14, line 10, for June read July.
— 14, — 19, for June read July.

550 4/VIII 1904

Explanation of the Maps.

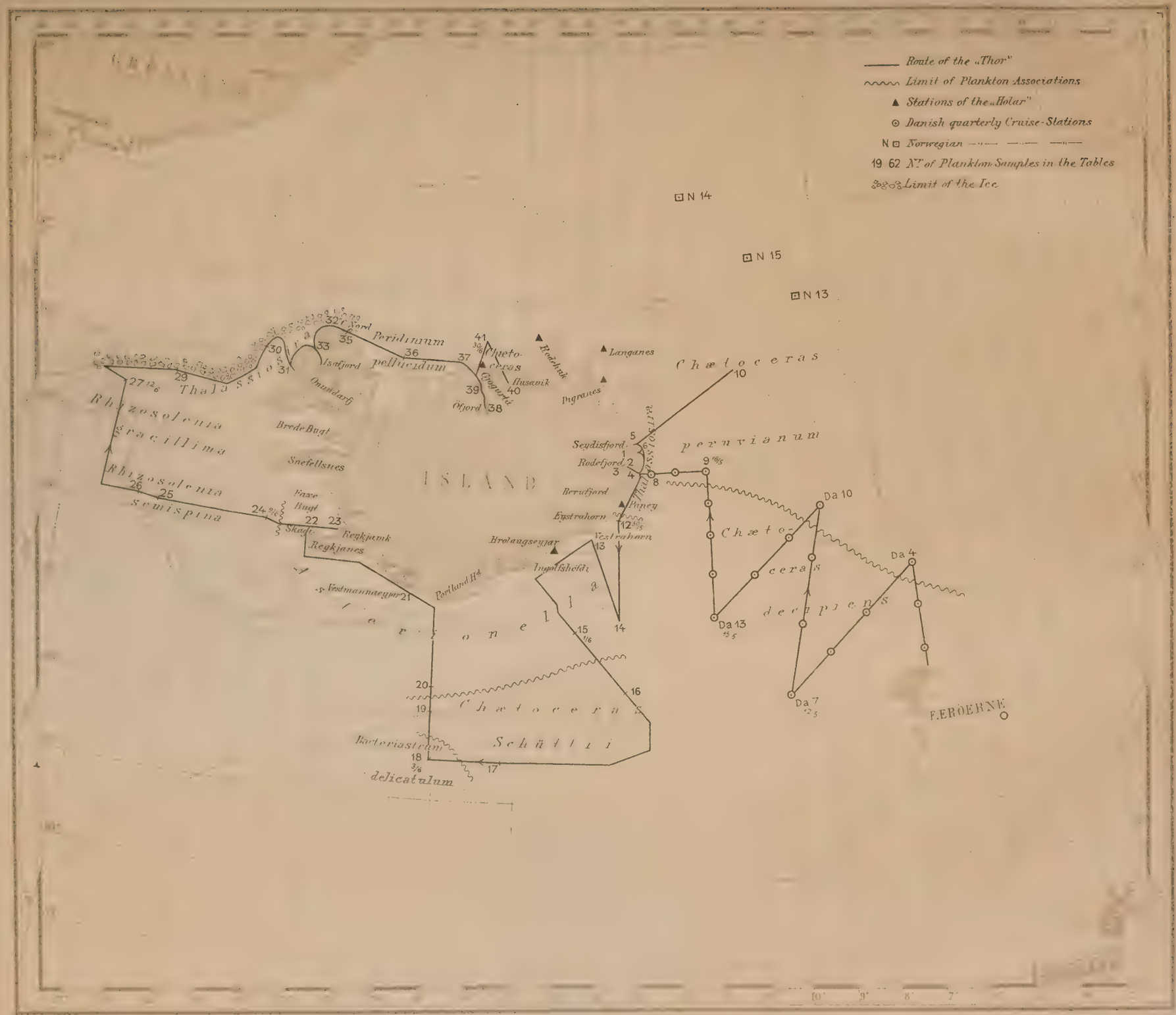
Map I: The outward route of the "Thor", May—June 1903.

Map II: The homeward route of the "Thor", July—August 1903.

The stations of the Danish quarterly cruises are marked ⊙Da and those of the Norwegian ⊡N, both with figures corresponding to the plankton tables published "in Bulletin des résultats acquis pendant des courses périodiques". The other figures (e. g. 16) refer to the plankton list Table II; to some of them the dates (e. g. $^{15}/_{5}$ ɔ. May 15th) are added. The broken curves are the isobaths (depths of 2000, 1000, 600 and 200 metres).

The sinous lines are the approximate limits of the plankton associations met with. The names of the plankton organisms indicate the leading forms of the associations.

It will be seen that the limits of the associations partly occur at about the same places in both maps, but the associations have changed; the most distinct limit is that at the southeast corner of Iceland where the warm Atlantic and the cold Arctic water are meeting eachother.


Route of the „Thor"
Limit of Plankton Associations
Stations of the „Holar"
Danish quarterly Cruise-Stations
N Norwegian
19 62 N:r of Plankton Samples in the Tables
Limit of the Ice
N 14
N 15
N 13
ISLAND
FÆRØERNE
Thalassiosira
Peridinium pellucidum
Rhizosolenia
Chætoceras
Ceratium
Isafjord
Omnidarfj
Breide Bugt
Snefellsnes
Faxe Bugt
Skagi
Reykjavik
Reykjanes
Vestmannaeyjar
Portland Hd
Ingolfshöfdi
Brotaugseyjar
Vestrahorn
Eystrahorn
Papey
Berufjord
Seydisfjord
Roderfjord
Langanes
Pigranes
Flusavik
Grögarfd
Öfjord
Raudinúk
Da 10
Da 4
Da 13
Da 7

GRØNLAND
ISLAND
FERØERNE
Route of the „Thor"
Limit of Plankton Associations
Stations of the „Holar"
Danish quarterly Cruise-Stations
Norwegian
Nr of Plankton-Samples in the Tables
Limit of the Ice
N 13
№ 46
Peridinium pellucidum
Chætoceras
Ceratium arcticum
Ceratium macroceras
Ceratium tripos
Peridinium
Dinophysis a.o.
Chætoceras Islandicum
Chætoceras furcellatum
Portland Hd
Ísafjord
Önundarfj.
Breide Bugt
Snæfellsnes
Vaxe Bugt
Skagi
Reykjanes
Reykjavik
Vestmannaeyjar
Hrolangseyjar
Ingolfshöfdi
Eystrahorn
Berufjord
Reydefjord
Seydisfjord
Djupanes
Langanes
Husavik
Öfjord
Eyjafjord
Papey
Thistlas
Stokksnes
Da 10A
Da 10
Da 9
Da 8
Da 7A
Da 7
Da 7B
Da 6
Da 5
Da 5A
Da 4
Da 4A
Da 4B
Da 4C
Da 4E
Da 4F
Da 3
Da 2
26° 25° 24° 23° 21°
300 400 500 600 Kilometer
1:3 000 000

MEDDELELSER FRA KOMMISSIONEN FOR HAVUNDERSØGELSER
SERIE: PLANKTON · BIND I · Nr. 2 1904

ON TWO NEW MARINE SPECIES OF HELIOZOA

OCCURRING IN THE PLANKTON OF THE NORTH SEA AND THE SKAGER RAK

BY

C. H. OSTENFELD

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI
1904

While occupied in determining samples of plankton which had been collected partly during the Danish quarterly cruises, partly with fortnightly intervals from Danish lightships, I found in several samples from the North Sea and the Skager Rak two organisms which on closer examination proved to be Heliozoa. Up to the present time only a few marine Heliozoa are known, and scarcely any true pelagic Heliozoa.

Dr. Penard in his last monograph of the freshwater Heliozoa (Les Heliozoaires d'eau douce. Genève 1904. 4°) seems to suppose that there is no true Heliozoon at all in the sea: "Il est donc juste de dire, dans un sens general, que les heliozoaires sont ayant tout des organismes d'eau douce; mais quelques-uns également appartiennent aux deux éléments à la fois; ils sont amphibiotiques". He mentions 11 marine species of Heliozoa[1]), but only two of them are according to him true Heliozoa, viz. *Acanthocystis italica* Gruber and *Pinacocystis rubicunda* Hertw. & Less; the last mentioned is probably identical with the freshwater-species *Pinaciophora fluviatilis* Greff, and it is possible that *Acanthocystis italica* which has been found in the harbour of Genoa, has been brought thither by a freshwater stream. Consequently he is right in his doubt concerning the marine habit of Heliozoa, but the two species described here are without doubt true marine forms. Moreover, as they are abundant in several samples and seem to have an interesting geographical distribution, I think it may be of interest to have the two forms described and figured in order to recommend them to the attention of other plankton-investigators.

I have only had material preserved in alcohol at my disposal and therefore have not been able to examine the pseudopodia and their arrangement. Both species observed are enclosed in an envelope, consisting of silicious bodies secreted by the animal, thus belonging to the group of *Chalarothoraca* Hartw. & Less. One of the species is a *Raphidiophrys* Arch., the other belongs to the genus *Acanthocystis* Cart.

I found the species *Raphidiophrys marina* n. sp. in samples from the lightships Horns Reef and Skagens Reef during the months October 1903—January 1904. In a sample from the Horns Reef collected on October 1st it even formed the chief component of the plankton. *Acanthocystis pelagica* n. sp. was found at the same stations as the preceding species, moreover in a sample from the Danish quarterly cruises in the Skager Rak in November 1903. I have also seen it earlier, in the year 1900, in samples from the lightship Skagens Reef, in others from the North Sea off the Channel of Tyborön and from the Lim Fjord near Nyköbing, everywhere in October—November. So we see that both species appear in autumn, when the Jutland current carries with it comparatively southern neritic plankton (Didymus-plankton), of which no doubt they form characteristic constituents.

Here follows a description of the species:

[1]) See also the excellent paper by F. Schaudinn: Heliozoa. Das Tierreich, Probelieferung. Berlin 1896.

Raphidiophrys marina n. sp.

Pelagic. Cells single (not in colonies), globular, ca. 70—80μ in diameter, with an envelope of loose tangentially arranged somewhat curving silicious needles, 15—20μ in length, evenly distributed over the whole surface of the cell, not in clusters; besides, we find (in preserved specimens) alien bodies (grains of sand) scattered over the surface. Ecto- and entoplasma not separated; nucleus one, somewhat excentric. In the preserved material the axial threads are not distinctly seen.

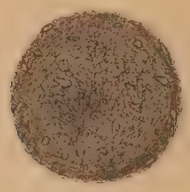


Fig. 1.

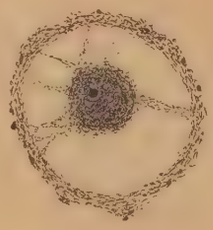


Fig. 2.

Fig. 3.

Raphidiophrys marina n. sp.

Fig. 1. Specimen seen from above; silicious needles and grains of sand. Plasma seen faintly through the envelope (Zeiss' Apochromat, Ob. $\frac{4,0}{0,95}$. Oc. 8).

Fig. 2. Specimen in optic section; plasma containing one somewhat excentric nucleus. A few plasmic protuberances proceed from the central part. Envelope formed of numerous silicious needles, with a few grains of sand on its surface. (Ob. $\frac{4,0}{0,95}$. Oc. 8).

Fig. 3. Silicious needles loose (after treatment with conc. H_2SO_4 and ignition put into styrax); bubbles of air are discernible inside. (Homog. Imm., Ob. $\frac{2,0}{1,40}$. Oc. 8.)

In plankton from the North Sea and the Skager Rak in the autumn and winter, especially in great abundance near Horns Reef at the beginning of October.

North Sea.

Horns Reef, Light-ship. 1903: $^{1}/_{1}$ (rr); $^{15}/_{1}$ (r); $^{2}/_{2}$ (rr); $^{16}/_{2}$ (rr); $^{3}/_{9}$ (+); $^{17}/_{9}$ (c); $^{1}/_{10}$ (cc); $^{15}/_{10}$ (rr); $^{2}/_{11}$ (r); $^{16}/_{11}$ (+); $^{2}/_{12}$ (r); $^{14}/_{12}$ (+).
1904: $^{14}/_{1}$ (r); $^{1}/_{2}$ (rr); $^{15}/_{2}$ (rr); $^{17}/_{3}$ (rr).

Skager Rak.

Skagen's Reef, Light-ship. 1903: $^{15}/_{1}$ (rr); $^{16}/_{2}$ (rr); $^{1}/_{10}$ (+); $^{2}/_{11}$ (r); $^{3}/_{12}$ (r).
1904: $^{18}/_{1}$ (rr); $^{1}/_{2}$ (rr).

This species is most closely allied to Raphidiophrys pallida F. E. Schulze (Arch. micr. Anat., vol. 10, p. 177, pl. 26, fig. 1) and related species (see PENARD, l. c., pp. 176—188), with which it has in common the shape of the silicious needles but it wants their arrangement in clusters. We see that the needles are tubular, as bubbles of air appear inside them when they are put into styrax after having been ignited. They are very slightly curved and very thin, less than 0,8μ in diameter. It is the first known marine species of the genus.

Acanthocystis pelagica n. sp.

Pelagic; cells globular, ca. 40μ in diameter, covered with a dense layer of radiating silicious staves and short tangential silicious plates. Ecto- and entoplasm distinct; nucleus one.

The radiating staves are 40—50μ in length, often slightly curved, pointed and with discoid basal part; beneath them lie thin silicious plates, whose longitudinal section appears almost linear, a trifle con-

tracted in the middle, but seen from above they consist of two flat triangular parts connected by a narrow piece (shape of a dumbbell); they are ca. 10μ in length.

Occurs steadily, but not in great quantity in plankton from the North Sea off the west coast of Jutland and from the Skager Rak in autumn (Sept. to Nov.), and has also been found in the western part of the Lim Fjord.

North Sea.

Horns Reef, Light-ship. 1903: $^{1}/_{10}$ (+).
Off the Tyborön Channel. 1900: $^{15}/_{10}$ (r); $^{16}/_{11}$ (rr).

Skager Rak.

Skagen's Reef, Light-ship. 1900: $^{16}/_{10}$ (rr); $^{16}/_{11}$ (rr).
1903: $^{1}/_{10}$ (+); $^{3}/_{11}$ (r).
Da 4. 1903: (150—50 M.) $^{1}/_{11}$ (+).

Lim Fjord.

Off Nyköbing. 1900: $^{7}/_{9}$ (rr); $^{21}/_{9}$ (r); $^{22}/_{10}$ (rr).

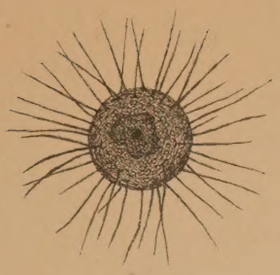


Fig. 4.

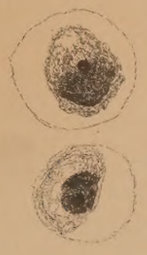


Fig. 5.

Fig. 6.

Fig. 7.

Acanthocystis pelagica n. sp.

Fig. 4. Specimen with plasma and nucleus discernible through the envelope (tinged with Haematoxyline). (Ob. $\frac{4,0}{0,95}$. Oc. 8.)

Fig. 5. Plasma of two specimens after removal of the staves. Ecto- and endo-plasma as well as nucleus are seen. (Haematoxyline.) (Ob. $\frac{4,0}{0,95}$. Oc. 8.)

Fig. 6. Radiating staves with basal parts seen laterally and in transverse section. (Water-Imm., Ob. $\frac{2,5}{1,25}$. Oc. 8.)

Fig. 7. Tangential plates seen in optic section after treatment with *KOH* (a); besides a single plate seen from above (b), (Water-Imm., Ob. $\frac{2,5}{1,25}$. Oc. 8.)

As yet only one marine species is known: *Acanthocystis italica* Gruber (Nova Acta Acad. Leopold, vol. 46, p. 508, pl. 9, fig. 35); but it is much smaller and has but one kind of silicious bodies.

Acanthocystis pelagica seems to be more closely related to *A. aculeata* Hertw. & Less., which possesses two kinds of silicious bodies, of which the radiating ones are almost similarly constructed in both species, but the peculiar shape of the tangential plates — rather difficult to see on account of their thinness — characterizes the new species. In some respects it is related to *A. erinaceus* Penard (Arch. Biolog., vol. 9, 1889); but it is easily distinguished by its larger size and its marine habit.

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